GUIDELINES FOR THE HEALTH IMPACT ASSESSMENT OF DEVELOPMENT PROJECTS

A health hazard has a potential to cause ill-health. The health risk indicates the extent to which the potential is realized.

Types of health hazards: see page 8
- Communicable disease
- Non-communicable disease
- Injury
- Malnutrition

Consider:
- Regional maps
- provincial health records
- see pages 12 & 13

Table 4 on page 16 has examples. Appendix 3 lists health hazards by sub-sector. Appendix 5-15 contains detailed reviews of known health hazards.

Output: a list of health hazards relevant to the project.

Go to next page.

ASIAN DEVELOPMENT BANK
GUIDELINES
FOR
THE HEALTH IMPACT ASSESSMENT
OF
DEVELOPMENT PROJECTS

OFFICE OF THE ENVIRONMENT
ASIAN DEVELOPMENT BANK
NOVEMBER 1992
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Appendix 5 Cross-cutting health issues
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Glossary
Physical and mental well-being of people is the ultimate rationale of efforts to foster economic development and to ensure that the process avoids or minimizes negative impacts on the physical environment, and through it, on people.

While acknowledging (albeit with some important qualifications) that economic growth has been mirrored by improvements in many health indicators in the countries of the Asia-Pacific Region, an impartial observer will have also noted a growing willingness to acknowledge the often complex (and far from unidirectional) interactions between economic growth and health and incorporate them into decision-making.

Not infrequently, the link that unites (i) economic activities, (ii) their impact on the physical environment and (iii) health, has been almost separated into two: the impact of economic activities on the environment and the effect of environmental changes on health. In drafting and implementing the procedures for environmental assessment of their investment activities, multilateral development banks and many overseas development assistance agencies have typically stressed the former link. Specialized agencies such as WHO and domestic regulatory bodies, on the other hand, have been putting more emphasis on the latter. Yet both groups of institutions are aware of the full extent of the interactions.

The guidelines presented in this document are an attempt by the Bank to complete, or at least be more explicit about, the “missing link”. The Guidelines use the terms Initial Health Examination (IHE) and Health Impact Assessment (HIA) to mirror the existing terms Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA). Rather than separate assessments, however, IHE and HIA are to be considered a subset of IEE and EIA respectively. Balanced environmental assessment of projects should simply encompass many things, including health.

The guidelines aim at presenting the subject matter systematically to a non-technical audience. They emphasize the method rather than providing extensive quantifications of the effects described. A reading list is attached for this purpose.

We hope that the guidelines, prepared in close collaboration between the Asian Development Bank and the World Health Organization, will serve their intended purpose and wish to encourage users to suggest improvements which could be incorporated into subsequent editions.

ADB-WHO Steering Committee
Guidelines for Health Impact Assessment

ACKNOWLEDGEMENTS

The principal author of this document is Dr M H Birley, Manager of the Liverpool Health Impact Programme (funded by ODA at the Liverpool School of Tropical Medicine, UK). The co-author is Professor G L Peralta, National Engineering Center, University of the Philippines. Both are members of the Joint WHO/FAO/UNEP/UNCHS Panel of Experts on Environmental Management for vector control (PEEM). The authors would like to acknowledge the advice and encouragement received from the mission leader Mr I Ruzicka, Office of the Environment, the assistance of Bank and WHO-WPRO staff and the advice of the Steering Committee. The Steering Committee consisted of B N Lohani (OENV), I Ruzicka (OENV), J Hunt (DPO), G Owens (AG4), J Jeugmans (IFEE), S Tamplin (WHO-WPRO) and J Storey (WHO-WPRO). Part of the general review of health hazards was extracted from an earlier document (HIP/91.03B) prepared for ODA by the principal author in collaboration with staff at the LSTM.

The authors would like to express their appreciation of the help which they received from secretarial and administrative staff at the Bank and especially in the OENV.

Special thanks are extended to the many Bank officers in Manila, Jakarta and Dacca who patiently discussed their interests and concerns and explained their procedures.

Final editing of this document was greatly aided by the HIP team: Dr A Hassan, Ms T Butler, Mr I Parry and Ms T Hewitt.
EXECUTIVE SUMMARY AND KEY TO THE GUIDELINES

1. Although development projects confer considerable benefits there is sometimes a hidden and uncomputed cost associated with health and safety.

2. Health impact assessment is part of environmental impact assessment.

3. A simple, rapid, operational procedure is provided for identifying health hazards and assessing whether the associated health risks may change as a result of the project. The procedure differentiates the construction, early and late operation phases of the project.

4. Experience of the health impact of existing projects is the best indicator of future health impacts. Accumulation of such experience in the Bank will accelerate the screening process.

5. Health risks are best managed by modification of the project environment and operating procedures, rather than by remedial action.

6. A review of known health hazards is provided in appendixes, classified by development sector. The review does not imply that all the hazards are equally likely or important.

7. The human population affected by a development project consists of many different vulnerable communities, or target groups, with different health risks.
A health hazard has a potential to cause ill-health. The health risk indicates the extent to which the potential is realised.

Types of health hazard, see page 6:
- Communicable disease
- Non-communicable disease
- Injury
- Malnutrition

For example, distribution of schistosomiasis

Is the project location health sensitive?

CONSIDER
- Regional maps
- Foci
- Provincial health records
see pages 12 & 13

Is there a health sensitive component?

Table 4 on page 16 has examples.
Appendix 3 lists health hazards by sub-sector
Appendices 5-15 contain detailed reviews of known health hazards

OUTPUT
a list of health hazards relevant to the project

Go to next page
The human population consists of separate communities distinguished by exposure, susceptibility, behaviour, occupation and location.

Examples of hazardous factors include:
- Biting by vectors;
- Contaminated water supply; and
- Dangerous machinery.

There are several national agencies with responsibility for health

- Health service
- Environmental protection agency
- Ministry of labour
Any increase in project-related health risk?

Yes

Assign to category A or B?

Consult Bank health specialist

Need HIA? page 34

Consider Health Risk Management page 39

Category C
No significant health impact

Health Impact Classification, table 5, page 21
A Significant health risks, mitigation may require special project components, HIA needed.
B Significant health risks, mitigation without special project component.
C No significant health risks.
### Guidelines

#### ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>AG</td>
<td>Agriculture</td>
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<tr>
<td>DMC</td>
<td>Developing Member Country</td>
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<td>DPO</td>
<td>Development Policy Office</td>
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<td>EIA</td>
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<td>Liverpool School of Tropical Medicine</td>
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<td>ODA</td>
<td>Overseas Development Administration (UK)</td>
</tr>
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<td>Office of the Environment</td>
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<td>OHS</td>
<td>Occupational Health and Safety</td>
</tr>
<tr>
<td>OHSC</td>
<td>Occupational Health and Safety Center</td>
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<tr>
<td>PBME</td>
<td>Project Benefit Monitoring and Evaluation</td>
</tr>
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<td>PEEM</td>
<td>Joint WHO/FAO/UNEP/UNCHS Panel of Experts on Environmental Management</td>
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<tr>
<td>SDU</td>
<td>Social Dimension Unit</td>
</tr>
<tr>
<td>STD</td>
<td>Sexually Transmitted Disease</td>
</tr>
<tr>
<td>TA</td>
<td>Technical Assistance</td>
</tr>
<tr>
<td>TOR</td>
<td>Terms Of Reference</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
<tr>
<td>WPRO</td>
<td>Western Pacific Regional Office</td>
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</table>

#### NOTE

In these guidelines "the Bank" refers to the Asian Development Bank with headquarters in Manila, Philippines.
A. Why Assess Health Impact?

The sustainability of development can only be ensured if the full range of potential impacts are appraised in a timely fashion and actions proceed from that appraisal.

The potential impacts of development are numerous and cut across many specialist concerns. Most development projects, from whatever sector, are expected to have a beneficial effect on human health. If the project is in the health sector the health benefit is direct and obvious. This paper is concerned exclusively with the non-health sectors, in which health impacts are an indirect consequence of the development. Sometimes the indirect impacts include unexpected negative effects on health. Many of these can be avoided by careful planning. The human population is not a single group. Adverse health impacts are most likely to affect the most vulnerable social groups; this may serve to amplify the overall adverse effect. Such impacts reduce the social and economic benefits expected from the development and transfer hidden costs to the health sector.

All development projects provide an opportunity for health promotion. An Initial Health Examination procedure (IHE) screens projects for health hazards as part of the Initial Environmental Examination (IEE). Often only minor actions may be required to safeguard health. In some cases more complex actions are required and a more detailed Health Impact Assessment (HIA) is indicated. The actions may vary from ensuring that the health authorities are informed of development plans, to specific requests for major planning changes, such as settlement siting.

Preventive measures may be cheaper, in the long term, than remedial action or curative medicine.

IHE and HIA determine, in broad terms, whether a significant health risk can be attributed to a project. By contrast, health risk assessment presupposes that an adverse effect exists and seeks to quantify it.
B. Who Should Use These Guidelines?

The principal audience for these guidelines are the Bank’s non-specialist staff, consultants in sectors outside the health sector and DMC officials. A number of health criteria are already intrinsic to project planning by the Bank. In the water sector, for example, the requirement for clean water and the routes by which water contamination occurs are well known. In the agricultural sector, food security, the causes and consequences of malnutrition and the occupational hazards of acute pesticide poisoning are well understood. Such issues are part of staff experience and expertise. There are many references to health concerns in the existing Environment Guidelines. See Appendix 1 for a review.

At the same time other health criteria have not been addressed. These include the vector-borne diseases such as malaria, filariasis and various arboviruses. Malaria, in particular, is a critically important disease, widespread in the region, difficult to control and cure. Project designs often create ideal breeding sites for the mosquito vectors and unwittingly increase malaria prevalence. There is often insufficient perception of mosquitoes and their breeding sites. Swampy land was commonly, and incorrectly, cited as the environment to avoid. The habitats of the malaria mosquito are described in Appendix 5.

Many health impacts are indirect, occurring "downstream". Some only become apparent after a decade or more. Prevention of health impact pivots on planning. A systematic approach to health impact assessment should increase perception and contribute to improved planning.
C. How to Assess Health Impact

The main tasks of health impact assessment are indicated in the flowchart, Figure 1. They include the following actions.

a. Definition of project type and location

Project title, location, department, executing agency and major project components are defined as part of the screening process and project classification.

b. Health hazard identification

This is the primary screen. See page 12. It is based on existing experience and the screening tools provided. It is undertaken by the Environment Specialist or Project Officer. The output is a long list of health hazards.

c. Initial Health Examination (IHE)

This is the secondary screen. See page 20. It uses rapid appraisal, secondary data and a fact-finding mission (if necessary). It is part of the IEE and should normally be undertaken at the pre-feasibility stage by the Project Proponent, Environment Specialist or Project Officer. The outputs are: a short list of the health hazards which may carry the most significant health risks; project classification of A, B, or C using the same system as for an IEE. The identification of a hazard short list is part of the scoping process.

d. Requirement for Health Impact Assessment (HIA)

A decision is made by the Environmental Specialist or Project Officer based on the experience of previous projects and the need to obtain further experience. Consult the Bank health specialists, as necessary.

e. Terms of Reference definition for HIA

A TOR is prepared for HIA which specifies the scope of the assessment. It includes, but is not limited by, the short list of health hazards identified by the IHE. See page 37.
Figure 1. Health Impact Assessment (HIA) Process, an Overview

**ACTION**

1. Definition of project type and location

2. Health hazard identification (page 12)

3. Initial Health Examination (page 20)

4. Need for HIA? (page 34)
   - Yes: TOR definition for HIA (page 37)
   - No: No further action

5. Health Impact Assessment (page 39)

6. Health Risk Management (page 39)

7. Project Benefit Monitoring and Evaluation

**INFORMATION OUTPUT**

- Long list of hazards
- Short list of hazards with potentially significant health risks
- Initial Health Examination sufficient for IEE
- Scope
- Health impact statement
- Health monitoring data
- Evaluation report
f. **Health Impact Assessment**

The assessment is undertaken by a specialist consultant. The output is a Health Impact Statement. The HIA may be a stand-alone study but, more typically, it will be part of an EIA.

g. **Health Risk Management**

The Health Impact Statement recommends health risk management actions including environmental management and health monitoring. Health monitoring data is an output. See page 39.

h. **Benefit monitoring and evaluation**

The project may be evaluated by either the Social Dimension Unit (PBME Section) or the Post Evaluation Office. In either case, the output should include a health impact evaluation report which can be used in future projects.
II TYPES OF HEALTH HAZARD

A health hazard has a potential to cause ill-health. The health risk indicates the extent to which the potential is realized.

Example Malaria is a health hazard in Manila but not a health risk, because there is no local mosquito species capable of transmitting the infection.

Although health must be viewed in its totality, for the purposes of impact assessment it is necessary to consider specific hazards and their components. The process of assessment consists of ranking these as likely to increase or decrease in magnitude as a result of the development intervention. The economic cost of the change in health hazard may be viewed as the additional cost of restoring to their previous state of health all the individuals who succumb to the additional hazard, plus the loss of production. That costing is outside the scope of this report.

It is convenient to divide the health hazards associated with development projects into four main categories, listed in Table 1.

<table>
<thead>
<tr>
<th>Health hazard</th>
<th>Examples and causes</th>
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<tr>
<td>Communicable disease</td>
<td>Malaria, diarrhea, respiratory infection</td>
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<tr>
<td>Non-communicable disease</td>
<td>Poisoning, pollution, dust</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>Reduced subsistence foods</td>
</tr>
<tr>
<td>Injury</td>
<td>Traffic accidents, occupational injury</td>
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</table>
A. Communicable Disease

Communicable diseases require infectious agents which multiply in the host. They may be transmitted in air, water, food, dust, blood products, body fluids, feces, soil and insect bite. In relation to development projects, they may be broadly sub-divided as follows.

- Diseases exacerbated by poor living conditions (scabies, meningitis, respiratory infection).
- Diseases of poor water supply and sanitation (diarrhea, cholera, typhoid, hookworm, hepatitis).
- Sexually transmitted diseases (HIV, gonorrhoea).
- Vector-borne diseases (malaria, scrub typhus, schistosomiasis).
- Zoonoses (pig tapeworm infection).

The most common childhood killers include diarrhea, respiratory infection, measles and malaria.

The infectious agents are distributed widely, but patchily, in the environment. Control may involve many small environmental modifications. Once an infection is introduced to a new community it may spread explosively from infected to uninfected people. Measles infection is an example.

B. Non-Communicable Disease

The non-communicable diseases include those which result from the ingestion, absorption or inhalation of chemicals and certain minerals. These may be associated with pollution and poor occupational safety. They are associated with organic damage. For example, dust inhalation damages the lungs. There are other diseases which are the result of stress.
Example: Agro-chemicals are often stored in the home and children play with empty, but contaminated, containers.

The vulnerability of the community to the health impact of pollution is increased by malnutrition, communicable disease and human behavior. In addition, pollution may increase susceptibility to communicable disease.

Example: Dust induced lung disease can facilitate infection with tuberculosis.

Some non-communicable diseases are the result of exposure to non-biological effluent produced at well-defined point sources. Control may involve effluent reduction. For example, emissions from a factory chimney has a single, controllable, source.

C. Injury

Exposure to new technologies, poor working practices, poor dwelling design, improper use of machinery and poor machinery maintenance lead to acute or chronic injury.

Example: Eye damage occurs in quarrying, hearing damage occurs in weaving factories, burns and scalds occur in metal processing. Burns and scalds may also follow the introduction of wood replacement cooking stoves.

Wounds provide a route of entry for infectious agents. Injured people are less productive and may suffer from malnutrition. Sick individuals may operate
machinery in a dangerous manner, increasing their vulnerability to further injury.

Low safety standards are common in many DMC’s. Occupational health and safety data is frequently unavailable. OHS is often not viewed as a matter for EIA’s, despite Bank Guidelines.

D. Malnutrition

All development projects are likely to have an impact on the food security and nutritional status of people living within (and possibly outside) the project area. Some agricultural projects will have improvements in food security as their specific objective. Other projects - such as mining, rural water supply, road construction - can have an impact on nutrition through a variety of indirect and possibly unplanned mechanisms. These include food production, food availability, workload, infection and feeding practices. They are described in more detail in Appendix 5.

Example

Production crops may require more weeding by women who then wean their babies earlier.

Under-nourished people are less productive and thus less able to obtain food. They are more susceptible to communicable disease. The disease, in turn, may reduce their ability to assimilate whatever food is available.

The effects of malnutrition include less than average weight or height, blindness, cretinism, anaemia and poor skin conditions. Especially vulnerable groups include young children and pregnant or lactating women. The household often cannot be considered as a unit when considering access to adequate food.

Projects could include in the TOR the following question. Will all the communities associated with the project have physical and economic access to adequate food at all times?
E. Other Health Problems

Mental health problems associated with the stress of new ways of living and the disruption of long established communities are likely to be important. Associated problems include alcoholism, suicide, violence, eating disorders, heart disease and raised blood pressure. Further research is needed before these issues can be assessed. See also Resettlement in Appendix 5.

F. General Aspects of Health Hazards

1. Interactions between health hazards and development

Although good health is not sufficient in itself, healthy people are believed to be more able to contribute positively to their own economic development, more willing to accept innovation, less likely to migrate to towns, more careful and more able to look after each other. They may be more likely to see themselves, and be seen by others, as the beneficiaries of development rather than its victims.

Health is associated with broader economic and demographic trends. Chronically sick populations have a lower economic output and less food may be produced or consumed. Poorer nutrition, in turn, increases susceptibility to disease and there is a downward spiral. Demographic trends are affected as more children may be required to compensate for those that are lost.


2. Latency

Some health hazards become health risks as soon as the community is exposed. This may occur while the community is in transition, during project construction, and health risk management must already be in operation. Other health hazards have a considerable latent period, ten years or longer, before they become apparent at the community level. Table 2 provides some examples. The operational conclusion is that health impact assessment must consider the whole life of the project.
Table 2: Examples of health problems with slow and fast onset

<table>
<thead>
<tr>
<th>Health categories</th>
<th>Slow onset</th>
<th>Fast onset</th>
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<tbody>
<tr>
<td>Communicable</td>
<td>Filariasis, schistosomiasis, hookworm, ascariasis, tuberculosis</td>
<td>Malaria, enteric infections, dengue, meningitis, pneumonia</td>
</tr>
<tr>
<td>disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-communicable</td>
<td>Dust induced lung disease, chronic poisoning, cancers</td>
<td>Acute poisoning</td>
</tr>
<tr>
<td>disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injury</td>
<td>White finger, hearing and sight loss, posture</td>
<td>Trauma (crushing, braking, wounding), burns, eye damage</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>Goiter, blindness, stunting</td>
<td>Wasting</td>
</tr>
</tbody>
</table>
III HEALTH HAZARD IDENTIFICATION

This is the primary screen which enables Bank staff to identify the health hazards associated with a project as a result of the following.

(i) Health sensitive location. Identified from maps, see section III.A, foci, see Section III.B and Figure 3, and provincial health records, see Section III.C.

(ii) health sensitive component. These are hazardous and hazard causing operations and materials. They may be identified from Section III.D, see Table 4 and Appendix 3, Section III.E and Appendixes 5-13.

The health hazards have been classed and described in section II (see Types of Health Hazard, page 6). Several health hazards may be important in each class and these may change between the construction, early and late operation stages (see Table 2, page 11). The Bank’s health specialists should be consulted.

The risks associated with these health hazards may depend on project location, design, operation, maintenance and community. The spatial boundaries of the hazards are variable, reaching, for example, far downstream and downwind in some cases.

The Bank Officer must use an informal scoping procedure to establish the temporal, spatial and communal boundaries for the hazards which should be included. The initial boundary should be wide. The process successively rejects more elements and produces a tighter focus.

The following primary screening tools should be used.

A. Maps

The World Health Organization publishes maps which indicate the distribution of various communicable diseases by country. For example, Geographical distribution of arthropod-borne diseases and their principal vectors (1989) and Atlas of the Global Distribution of Schistosomiasis (1987). Figure 2 is an example.

Some DMC’s publish provincial distribution maps of a range of diseases and health indicators. For example, the Department of Health, Indonesia, published maps of provincial health data in 1990. The maps cover demography, malnutrition, a wide range of communicable diseases, and health service provision. The Bank could develop a Geographical Information System containing such health data and include it in country profiles.
B. Foci

Within each country, province or district the distribution of health hazards is patchy, or focal. It is often associated with particular topography, habitat or point sources. Figure 3 illustrates some general associations between vector-borne disease and habitat. There are regional variations. The habitat requirements of malaria and schistosomiasis are described in more detail in Appendixes 5 and 6.

C. National and Provincial Health Records

Many DMC’s publish an annual list of the ten leading causes of mortality and morbidity, based on hospital records. See Table 3. The accuracy of such data is limited at the project level. Nevertheless, it provides an indication of existing health hazards. The health risks associated with many of these health hazards may or may not change as a result of the project. Appendix 4 provides an additional assessment of the value of national health records.
Figure 3
Some associations between vector-borne disease and habitat in Asia

Source
Guidelines for forecasting the vector-borne disease implications of water resources development.
M H Birley, 1991, WHO/VBC/91.3
PEEM Guidelines Series 2
Table 3: Example: leading causes of morbidity in the Philippines, 1988

<table>
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<tr>
<th>Cause</th>
<th>National</th>
<th>Bohol</th>
<th>N. Samar</th>
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<td>Influenza</td>
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<td>Tuberculosis</td>
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<td>5</td>
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<tr>
<td>Malaria</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accidents</td>
<td>7</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Heart Disease</td>
<td>8</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Measles</td>
<td>9</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Tumors</td>
<td>10</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Inf. Hepatitis</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td></td>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>

D. Summaries of Known Hazards

Table 4 indicates health hazards which may be important at each project stage. More detailed tables are included in Appendix 3 for the following subsectors: Irrigation; Industry, including fertilizer and cement manufacture; Fisheries and Aquaculture; Watershed Development; Forestry; Land Clearing and Rehabilitation; Dams and Reservoirs; Coastal Zone Development; Thermal Power; Mining and Mineral Processing; Energy distribution; Airports; Highways and Roads; Ports and Harbors; Urban Development.

The following points are relevant.

- Health hazards which have a high frequency and severity, and which are preventable or controllable, should receive the highest priority.
- The most important tool for assessing what could happen is the experience of similar projects in the region.
- Some health hazards may not have a significant health impact until a project has been operational for more than ten years.
- There will always be additional hazards of importance in specific projects.
Table 4: Examples of health hazards, causes and mitigations, by project stage

<table>
<thead>
<tr>
<th>Project Stage</th>
<th>Communicable disease</th>
<th>Non-communicable disease</th>
<th>Injury</th>
<th>Malnutrition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Location</td>
<td>Vector-borne disease foci; Animal reservoirs (zoonoses); Fecal contamination of water supplies; Insanitary waste disposal; Access to fuel and water supplies</td>
<td>Waste storage and discharge; Accidental release of toxic materials; Dust, noise, fumes; Pesticide drift; Chemical contamination of water supply</td>
<td>Traffic hazards; Floods, tidal waves, landslides, insurgency, communal violence, fire and explosion, earthquakes</td>
<td>Access to: wild foods, traditional medicines, fuelwood, water, home gardens, markets</td>
</tr>
<tr>
<td>Planning and design</td>
<td>Insanitary waste disposal; Vector source reduction; Water supply</td>
<td>Waste disposal; Water supply; mineral and chemical content</td>
<td></td>
<td>Food supplement program; Provision of home gardens</td>
</tr>
<tr>
<td>Construction</td>
<td>Fecal-oral disease; Water supply; Excreta management; Vector-borne diseases; STDs</td>
<td>Hazardous material handling; Dust, fumes; Alcoholism</td>
<td>Explosion, fire, vibration, noise, eye damage</td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>Fecal-oral disease; Water supply; Excreta management</td>
<td>Toxic substances, noise, heat, dust “gas eye”</td>
<td>Fire and explosion</td>
<td>Food insecurity</td>
</tr>
<tr>
<td>Opportunity for enhancement</td>
<td>Environmental improvements</td>
<td>Pollution control</td>
<td>Operating procedures</td>
<td>Food insecurity</td>
</tr>
</tbody>
</table>
E. **Reviews of Known Health Impacts**

Appendices 5-13, in Volume 2, contain extensive reviews of the health hazards which have been recorded in association with specific development sectors. The review is organized by sector and establishes linkages with health hazards. The purpose of this review is to identify potential problems. Not all will be important in each project.

**Example**

The following samples of the material in the review are associated with Figure 4.

Transport systems provide a conduit for the distribution of communicable disease such as HIV and malaria. Transport is also an important cause of traumatic injury.

Underground miners can suffer from permanent dust-induced lung damage and associated tuberculosis. Miners also suffer from high rates of traumatic injury.

Household cooking on an open fire may be the largest single occupational health problem of women. It can lead to many respiratory and eye diseases.

Rice development projects may create breeding sites for mosquitoes which transmit Japanese encephalitis. Pigs near the rice fields amplify the virus.

Malnutrition is frequently a serious problem among the dependents of plantation workers.

Coastal Asian towns constructed with inadequate drainage breed huge numbers of the mosquitoes which transmit lymphatic filariasis.

High rates of respiratory disorders, neonatal mortality and birth deformities are associated with high levels of water and air pollution.

In developing countries generally, the annual rate of accidents causing disabling injuries to workers is much higher than in many developed countries.
Figure 4
Some health hazards of development projects
Figure 5. Procedure for Initial Health Examination (IHE)

1. Define the project type and location
2. Health hazards identification
   - Describe and rank community vulnerability page 21
   - Describe and rank environmental factors page 25
   - Describe and rank protection agency capability page 26
3. Assess the project related change in health risk (complete Summary IHE table) page 30
4. Any increase in project related health risk?
   - No: Category C
   - Yes: Category A or B
5. Identify safeguards and mitigation measures or arrange for HIA
IV INITIAL HEALTH EXAMINATION (IHE)

Figure 5 illustrates the procedure for IHE. Equipped with a list of health hazards from the primary screen, the Project Officer or Environmental Specialist will use the IHE tool to interpret the health risks. This step requires identifying three sub-components and completing the Summary IHE Table, Figure 7, page 30.

- Vulnerable communities;
- Environmental factors;
- Capability of protection agencies.

Each component should be ranked as a major or minor influence on health risk.

Example

Malaria has a high health risk during the construction phase of a project in a forest fringe area. The workforce are likely to be highly vulnerable, the forest is a very important factor in malaria transmission, and the capability of the health service to protect the workforce is likely to be low.

A rapid appraisal will be required, using secondary information and interview coupled with a site visit (if necessary). The appraisal should answer the following questions.

- Are there any similar projects in the region?
- What health impacts are associated with these projects?

For each health hazard which has been identified:

- What communities are vulnerable? Describe their behavior, susceptibility or work practices.
- What environmental factors are associated with the health hazard?
- What is the capability of local health services and other protection agencies to monitor, survey, safeguard and mitigate?
The output will be a classification of health impact similar to the environmental classification system. See Table 5.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Significant health impacts, mitigation difficult or requires HIA or requires special project component</td>
</tr>
<tr>
<td>B</td>
<td>Significant health impacts, mitigation practical without special project component, may require HIA</td>
</tr>
<tr>
<td>C</td>
<td>No significant health impacts</td>
</tr>
</tbody>
</table>

A. Vulnerable communities

The population can be grouped according to age, sex, education, occupation, income, cultural and religious group, family size, nutritional status, behavior, exposure or susceptibility. Groups may be difficult to identify and do not remain static. The project related health hazards associated with particular groups are reviewed in Appendixes 5-13.

Example

Pregnant and lactating women are specially vulnerable to malaria and this is relevant to settlement siting.

Most projects are expected to be overwhelmingly beneficial to the health and economic well-being of many communities. Others, the vulnerable communities, may unfortunately experience some adverse health consequences. Table 6 indicates the nature of some vulnerable communities. The Bank’s Guidelines for Social Analysis of Development Projects (being revised) provides more detail.

Primary communities are those who are directly affected by the project. They will either already live in the project area or they will be imported for the project. Some of them will be specifically identified as project beneficiaries.

Secondary communities are those indirectly affected by the project. For example, they may be attracted to the project site by the opportunities which it
offers or displaced from land which they have traditionally used. Although these communities are not part of the project plans they may be numerically far greater than the primary communities and suffer from more severe health risks.

Many projects draw poor migrants from a wide hinterland. As they become squatters in the project area they are especially vulnerable to the diseases of poor living conditions. They retain links with their original homes and may carry diseases back with them to dependents who become vulnerable in their turn.

The needs of women in development are now widely recognized. These include specific health hazards which are changed by development projects.
Table 6: Examples of vulnerable communities whose health may be changed by a project

<table>
<thead>
<tr>
<th>Vulnerable groups</th>
<th>Why or what</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction workers</td>
<td>OHS</td>
</tr>
<tr>
<td>Camp followers</td>
<td>Communicable disease</td>
</tr>
<tr>
<td>Project workforce</td>
<td>OHS</td>
</tr>
<tr>
<td>Local dependents</td>
<td>Malnutrition, the household cannot be treated as a unit</td>
</tr>
<tr>
<td>Distant dependents</td>
<td>Malnutrition in the labor reserve, communicable disease imported by circulating labor</td>
</tr>
<tr>
<td>Casual labor</td>
<td>Communicable disease</td>
</tr>
<tr>
<td>Women employees</td>
<td>Violence, miscarriage, fetal damage</td>
</tr>
<tr>
<td>Child labor</td>
<td>Communicable disease, injury</td>
</tr>
<tr>
<td>Displaced communities</td>
<td>Malnutrition due to loss of subsistence</td>
</tr>
<tr>
<td>Resettled communities</td>
<td>Communicable disease, malnutrition</td>
</tr>
<tr>
<td>Periphery</td>
<td>Pollution, malnutrition</td>
</tr>
<tr>
<td>Downstream/downwind</td>
<td>Pollution</td>
</tr>
</tbody>
</table>

Specific sub-sectors

<table>
<thead>
<tr>
<th>Sector</th>
<th>Why or what</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers and agricultural laborers</td>
<td>Communicable disease (including zoonoses), agro-chemical poisoning, crop-specific hazards</td>
</tr>
<tr>
<td>Forestry workers</td>
<td>Communicable diseases (including malaria), injury</td>
</tr>
<tr>
<td>Tourists and tourist servers</td>
<td>Communicable diseases, stress related diseases</td>
</tr>
<tr>
<td>Industrial employees</td>
<td>OHS</td>
</tr>
<tr>
<td>Fishing folk</td>
<td>Malnutrition due to disruption of coastal resources</td>
</tr>
</tbody>
</table>

Checklist

- [ ] Have all the communities associated with the project been identified?
- [ ] Do any of them appear to be especially vulnerable to the project as a result of location, behavior, exposure, age, gender or cultural reasons?
Figure 6
Effect of development projects on health and intervention points for protection agencies
B. Environmental factors

Figure 6 illustrates the interaction between development projects, the environment and the community. The community is exposed to the environment through its location, occupation and behavior.

Example

In the chemical sector, exposure to toxic chemicals can occur through skin contact, inhalation or ingestion. In the irrigation sector, exposure to vector-borne diseases can occur through skin/water contact and arthropod bite.

Examples of hazardous environmental factors include locations, habitats and structures, such as:

- proximity to industrial plant;
- within flight range of the breeding sites of insect vectors;
- domestic water supply downstream of excreta disposal;
- poorly maintained irrigation ditches which serve as vector breeding sites;
- swamp habitats of the schistosomiasis snail host;
- poorly maintained roads with numerous traffic accidents.

Examples of behavioral changes which reduce exposure to a health hazard include:

- maintenance of irrigation ditches to prevent mosquito breeding;
- avoiding the swamp habitat of the schistosomiasis snail host;
- boiling contaminated drinking water;
- defensive driving.

Identification of important environmental factors is the most complex task of IHE within the IEE. For example, the environmental factors associated with vector-borne disease hazards are described in WHO’s Guidelines for Forecasting the Vector-Borne Disease Implications of Water Resources Development (Birley, 1991). They include: vector species, pesticide resistance, seasonality, host blood preference,
breeding site requirements, reservoir hosts, flight range, and resting behavior. Other examples are described in the Appendixes.

During the fact-finding mission the Project Officer should seek local specialist advice at the Ministry of Health. This will include a communicable disease division and a vector-borne disease section.

Checklist

☐ Are there any features of the environment which promote exposure to health hazards?

☐ Are effective mitigation measures easily available?

C. Capability of protection agencies

In most DMCs, several agencies are jointly responsible for human health. The health service is responsible for routine health data collection, curative and preventative services. Environmental protection agencies regulate and monitor compliance with waste emissions, water and air quality, noise and, sometimes, occupational health and safety regulations. Ministries of Manpower are frequently responsible for OHS. Ministries such as public works, agriculture and industry may have EIA committees which oversee compliance with national environmental protection regulations. The Bank's Environmental Paper No. 2 surveys the environmental legislation and the implementing agencies in selected DMCs. The capability of these agencies is limited by economic, staff, and infrastructure resources.

In most DMCs, environmental protection agencies are very new compared to health agencies. Their initial functions tend to be oriented towards pollution control or land-based concerns rather than communicable disease, malnutrition or OHS. For their part, health agencies have a limited regulatory function. They typically have Environmental Health departments responsible for sanitation and water and food quality inspection. They have little or no experience of planning and regulating projects which are primarily associated with other sectors. They can measure the prevalence rates of communicable diseases, injuries, malnutrition and the symptoms of ill-health. They are not involved in OHS; this is normally the responsibility of the Labor, Manpower or Human Resources agency.
The capabilities of health agencies are surveyed by the World Health Organization. WHO statistics are split between the Regional Office for South-East Asia in New Delhi and the Regional Office for the Western Pacific in Manila. National health statistics reveal the broad differences between national capabilities.

While the institutional background is clearly relevant to any balanced assessment of health impacts, the purpose of EIA and HIA, strictly speaking, is not to assess the capability of environment protection agencies. Rather, it is to identify the institutions and mechanisms, of whatever label, which will undertake health review and monitoring.

Example

A country with an annual per capita health expenditure of under $10, such as the Philippines, may have a different capability to a country whose expenditure is over $100, such as the Cook Islands. However, some countries provide good health services at low cost. A country with an infant mortality rate of over 10%, such as Pakistan, has a demonstrably lower capability than Singapore, with less than 1%.

In many countries, health statistics may be inaccurate due to under-reporting. Some diseases are notifiable but compliance may be poor. Appendix 4 discusses the availability of health information.

A summary of health service capability for each DMC could be prepared in order to identify requirements to strengthen them.
Example

Diarrheal diseases are the third principal cause of death in pre-teen Malaysians and a leading cause of pediatric hospital admissions. Incidence was greatly under-reported due to the following factors:

□ Data was not reported by private practitioners.
□ Rates of under- and non-reporting were very high.
□ Terminology was not standardized (the terms gastroenteritis, diarrhea and food poisoning were all used).
□ Specific diseases such as cholera, dysenteries and typhoid were often reported separately.

The "hardware" requirements for preventing water-borne diseases in water supply and sanitation projects are often well understood. The "software", including health education and maintenance, still presents a problem.

Very few countries are likely to have institutional procedures for minimizing vector-borne health risks through project design, although this is seminal. Many countries only have insecticide based vector control programs, which are unsatisfactory mitigation measures.

In rural areas access to health care may be determined by walking distance. Acceptable walking distance varies with culture, topography and poverty. An estimate of access is the percentage of the community who live within walking distance. If a road is constructed, more distant communities may gain access using public transport. It should not be assumed that accessible health care is already available.

1. Using rate information

The prevalence rate is the number of cases of the condition at a particular time divided by the size of the exposed community. The rate will

\[
\text{Prevalence rate} = \frac{\text{Number of cases}}{\text{Number of people exposed}}
\]

vary over time. It may stabilize, peak, cycle, or change with the seasons. It may be relatively stable, or unstable and epidemic. Both point and period prevalence rates are commonly used. The intensity of the condition may also vary between individuals, causing greater or lesser disability. Many diseases have a long latency period. They may not become apparent for ten or more years and cannot be easily attributed to a specific project or source of effluent.

In order to interpret data about the ill-health of a community it is crucial to use rate data. Unless the data is expressed as rates it is impossible to compare the health risk experienced by different communities or the time trend in a single community.

One simple measure of the capability of a health protection agency is the evidence that rate information is routinely being used. The skill to use rate information is far from common at both national and district level and the census data, which provides the denominator, may not be accurate. See also Appendix 4. Action may be required to strengthen the capability of protection agencies through further training.

2. Checklist

☐ Do the project communities have realistic access to health services based on distance, cost and time to travel, opening times, drug supplies, trained personnel availability, gender and age?

☐ Is routine health surveillance data accurate, calculated as rates, displayed in graphs, used in decision-making, of comparative or absolute value?

☐ Are health center diagnostic facilities functional, quality controlled, timely?

☐ Do health statistics travel down the line to the periphery as well as up to regional headquarters?

☐ Do peripheral health centers have functional water supplies and latrines as well as drug supplies and diagnostic equipment and are personnel paid regularly?

☐ Have the checklists in the social infrastructure section of the Bank's Guidelines for Social Analysis of Development Projects (being revised) been consulted?
Figure 7.
Initial Health Examination (IHE) summary table

<table>
<thead>
<tr>
<th>Project type</th>
<th>Location</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>HEALTH HAZARD</th>
<th>HEALTH RISK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable disease</td>
<td></td>
</tr>
<tr>
<td>Non-communicable disease</td>
<td></td>
</tr>
<tr>
<td>Nutrition</td>
<td></td>
</tr>
<tr>
<td>Injury</td>
<td></td>
</tr>
</tbody>
</table>
Do the capabilities of the environmental protection agency require strengthening?

Do the capabilities of the health service require strengthening?

Do the capabilities of the office responsible for OHS require strengthening?

Is the Ministry of Health represented in the EIA procedure, project design or approval process?

D. Initial Environmental Examination Report

The Bank uses a standard form for identifying the project, department, division, staff preparing IEE, date of review, major project components and so on. It is proposed that the health impact component should be summarized in a matrix. See Figure 7.

As there may be health risks even if the project is not implemented, only the change in health risk is strictly associated with the project.

1. Explanation of the IHE Summary Table

The project type and location assist the user to identify health hazards. Health hazards have the potential to cause ill-health. The health hazards are sub-divided into four main categories. There are many different hazards in each category. The health risk depends on the community exposure to the hazard, the environmental factors which promote that exposure and the capability of protection agencies, such as the health service, to safeguard health. Simple scores should be used such as: unchanged, increasing, decreasing.
### Table 7: Example of a Summary IHE

<table>
<thead>
<tr>
<th>Health Hazard</th>
<th>Community Vulnerability</th>
<th>Environmental Factors</th>
<th>Health Service Capability</th>
<th>Health Risk (associated with project)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td>Susceptibility is high and labor migration may introduce the parasite</td>
<td>Vector habitat depends on reforestation</td>
<td>Curative - drug resistance Surveilliance - localized Vector control - in response to outbreaks</td>
<td>Check in ten years after significant reforestation</td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td>Leading cause of local morbidity, severe cases reported</td>
<td>Snail populations surveyed at project site</td>
<td>Curative, snail control and surveilliance, but staff shortage</td>
<td>High risk, but mitigation practical</td>
</tr>
<tr>
<td>Dengue Hemorrhagic Fever</td>
<td>Low in rural areas</td>
<td>Vector widespread</td>
<td>Hospitalization of cases</td>
<td>Very low and unchanged</td>
</tr>
<tr>
<td>Encephalitis (J.E.)</td>
<td>Low, no cases reported</td>
<td>Vectors probable</td>
<td>Supportive treatment</td>
<td>Very low and unchanged</td>
</tr>
<tr>
<td>Pesticide poisoning</td>
<td>High - poor education</td>
<td>Increasing agricultural usage of extremely toxic substances</td>
<td>Vigilance probably low</td>
<td>Moderate, increasing, mitigation required</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>High but reducing with improved income</td>
<td>Intensive rice production, fisheries</td>
<td>High</td>
<td>Moderate, check that fish consumption increases as planned</td>
</tr>
<tr>
<td>Traumatic injury</td>
<td>Low</td>
<td>Draft animal power</td>
<td>Casualty ward</td>
<td>Low, unchanged</td>
</tr>
<tr>
<td>Enteric and other helminth infections</td>
<td>High prevalence</td>
<td>Tube wells, open defecation, no domestic water supply component</td>
<td>Curative</td>
<td>Unchanged, but domestic water supply required</td>
</tr>
</tbody>
</table>
Example Explanation to accompany Summary IHE in Table 7

Malaria is variably endemic throughout the Philippines with an epidemic potential and multiple drug resistance. Vector breeding is restricted to shaded streams and irrigation ditches. Successful watershed reforestation may create a vector habitat in about ten years. Good maintenance of watersheds and irrigation ditches would minimize the risk. If the surveillance system remains locally operational it should be able to respond to renewed transmission.

Schistosomiasis is endemic at and near the project site. The snail vector inhabits streams and ricefields. Proper operation and maintenance would minimize this risk. There is an active surveillance system and curative drugs are available but there is a local staff shortage.

Dengue is largely restricted to towns and cities where population density is high. Japanese encephalitis is rare in the Philippines. The vector probably occurs locally but there is probably no reservoir of infection. Pigs can be an important reservoir host but no intense pig rearing is planned at the project site.

Pesticide poisoning has been recognized as an important health hazard of intensive rice cultivation in the Philippines. Farmers are poorly informed of appropriate methods of handling pesticides. Agricultural promotion emphasizes pest resistant varieties of rice and IPM methods but this may not be adopted by local farmers. Little pesticide is currently being used at the project sites but an increase is foreseen. Extremely hazardous pesticides are on sale locally and continuing efforts are required to restrict their use.

Traumatic injury associated with farm machinery is unlikely to become a problem as draught animals are commonly used.

Malnutrition is a recognized problem. Improvement expected in the income of farmers and farm laborers without reduction of subsistence crops. Proposed fish aquaculture may improve the diet, if implemented.

Enteric infections associated with diarrhea and typhoid are among the leading causes of morbidity. Geohelminth infection is common. The drinking water supply is drawn from open wells and open defecation is common. The program contains no components which will reduce this health risk. Safe domestic water supply is required.

Rating The project is rated B with the recommendation that action is taken to strengthen local health education through agricultural extension so as to prevent schistosomiasis and pesticide poisoning. The community should be consulted regarding domestic water supply.
V HEALTH IMPACT ASSESSMENT

A. Which Projects Require a Full Health Impact Assessment?

At this stage, according to Figure 5, the project is classed into the usual environmental categories A, B and C, listed in Table 5, page 21. The project will receive a similar classification to the IEE. The overall classification, for both health and environment, should be the most cautious of the two component classifications.

The project officer must then decide whether a full health impact assessment, requiring the services of a specialist consultant, is necessary (review Figure 1). Consult the Bank’s health specialists. In the first instance, it is recommended that the most cautious line of action is followed: if in doubt - do an HIA. As experience is gained of the outcome of HIA in different sub-sectors, it may be possible to accelerate the process and proceed directly to the specification of mitigation measures.

If an HIA is required a TOR will be prepared for a specialist consultant. The IHE will have identified the health hazards and communities which the TOR should address. The health risk assessment should seek to establish whether the health risk associated with these particular health hazards, community and project stage will increase, decrease or remain unchanged as a result of the project.

B. Components of HIA

As a result of the IHE, the HIA can focus, in depth, on a small number of significant health hazards. During the feasibility study, the consultant should assess the health risk associated with each health hazard at each project phase and for each vulnerable community. The assessment is concerned with the change in exposure associated with the project: identifying the communities which will be exposed and the nature, magnitude and likelihood of that exposure. The consultant should also establish the capabilities of existing protection agencies, including the health service, to monitor, inform, safeguard and mitigate health risk.

The conclusions of the assessment must be presented to the decision makers in a format which will enable them to use the information effectively. The same summary table used for IHE is recommended.
The cycle of hazard identification and risk interpretation may have to be repeated. First, as a rapid appraisal and second as a detailed study of the major risks. The feasibility study should provide the information required for negotiating changes in project plans or operation to safeguard health.

C. Scoping

During preparation of the TOR it will be necessary to establish the boundaries for the consultant. These will include the hazards to be addressed, the communities of interest, the spatial boundaries and temporal phases for which a prediction is required. One of the consultant's tasks will be to refine the scope.

Example

In chemical plants, the scope may include the whole of the flow-cycle from extraction of raw materials through to waste disposal, the lifetime of the workforce and the spatial limits at which gaseous discharges can be detected.

a. The spatial boundary

The influence of a project extends far beyond the project site. The economic opportunities draw formal and informal labor which retain links with distant communities. Vectors breeding on site disperse downwind. Effluent discharged into streams and air flows are carried many kilometers. Toxins may accumulate in the food-chain and affect the health of communities to whom the food is exported.
Example

A large project was completed to supply a city with a new piped sewerage system. The engineering focus was on removing raw sewage from the city streets. The main sewerage pipes led to a primary treatment plant. The septic fluid was then discharged into open drains which were beyond the bounds of the engineering project. The unfenced drains flowed through densely populated suburbs and the community had intimate contact with the septic fluid, even extracting it for domestic use. The boundary of the health impact assessment had to be larger than the boundary of the engineering problem.

b. The temporal boundary

Four main project stages may be identified:

- pre-project;
- construction;
- early operation;
- late operation (after 10 years).

In many cases, the health hazards are present and causing substantial health risks independently of the project. A prediction is required of the change in project related risks during the lifetime of the project.

Some health risks may become apparent immediately. Others may remain unapparent until the late project phase. Risks which have long latency periods may not normally be considered in development planning. However, they may be seminal to health impact assessment. See Table 2, page 11, for examples.
D. Generic Terms of Reference for Health Impact Assessment

The Generic Terms of Reference for Health Impact Assessment comprises the following components.

1. Introduction

This states the purpose of the terms of reference, the type of project to be assessed, and the implementing arrangements for the health impact assessment.

2. Background information

This provides a brief project description with the objectives, the status and timetable, and the project proponent. Related projects within the region must be identified.

3. Objectives

This states the general as well as specific objectives of the health impact assessment in relation to the project preparatory activities such as feasibility studies (planning, design and execution) and as part of environmental impact assessment.

4. Environmental requirements

This section identifies regulations and guidelines which will govern the assessment such as the Bank’s Operational Directive, national laws or regulations, regional or provincial regulations, and specific regulations of other funding organizations involved in the project. The requirement for health impact studies is currently included in the EIA regulations.

5. Study area

This specifies the boundaries of the study area for the assessment. It should include the human communities downstream and downwind of the project.
6. **Scope of work**

The health hazards and communities that require particular attention are obtained from the IHE Summary Table. The Consultant will be asked to refine the scope of work for contracting agency review and approval.

7. **Health risk assessment**

The Consultant will assess the health risk associated with each health hazard at each project phase. The assessment will include the following considerations.

a. **Community vulnerability**

Identify each vulnerable community to be affected by the project and assess the nature, magnitude and likelihood of exposure. Estimate the prevalence rate of each hazard in each vulnerable community from health sector records and/or special survey.

b. **Environmental factors**

Consider the environmental factors that may contribute to an increase in health risk and define mitigating measures as input to project planning. Estimate the magnitude of the factors.

c. **Capability of protection agencies**

Establish in more detail the capabilities of existing protection agencies, such as the environmental and health agencies, which have jurisdiction over the project site. The consultant should assess the limitations of existing data and recommend how to strengthen health information systems to meet Bank requirements for health risk management.

8. **Health risk management**

Formulate a monitoring program during the construction and operational stages which includes: a description of the work tasks, skills/tests/interviews, frequency, institutional and financial arrangements, justification/use of the monitoring data. Define the safeguards and mitigating measures required as inputs to the feasibility study.
9. **Consultant requirements**

The Consultant must have previous experience of assessing the health impacts of development projects. The Consultant must have specialist knowledge of the most significant health risks identified during the IHE. If diverse health risks were identified then additional consultants may be required with specialist knowledge of each.

10. **Reports, duration and schedule**

This will specify the total period of the study, staff-months of experts, dates for consultation, periodic reports and other target dates.

11. **Other information**

This will provide the consultant(s) with preliminary information on data sources, background reports and studies, and other relevant publications.

**E. Health Impact Statement**

The output from an HIA will be a health impact statement which will supplement the EIA report. This should be modelled on the IHE. It should include a summary table similar to Figure 7, page 30. The table should be supported by an explanation of each item. This should be similar to the example on page 33. However, much more detail should be available.

**F. Health Risk Management**

The risk assessment is presented to an audience of decision makers who must evaluate the relative importance of the impacts which have been identified in a wider context. They will decide the priority to attach to the recommended safeguards and mitigation measures, negotiate resources and assign monitoring and surveillance tasks.

Risk management consists of incorporating safeguards and mitigation measures in project design and operation. Safeguarding entails proposing modifications to project plans and operations and ensuring that the capability exists for effective mitigation. This could include strengthening of protection agency capabilities.
Mitigation entails vigilant monitoring for the lifetime of the project followed by appropriate and timely response to increasing health risks. Monitoring depends on an adequate health information system. Response may depend, for example, on stocks of insecticides and drugs and their dissemination and use.

Table 8 indicates some of the actions and concerns which should be addressed during each project stage.
### Table 8: Health risk management: Bank actions

<table>
<thead>
<tr>
<th>Project Stage</th>
<th>Surveillance and monitoring</th>
<th>Health service provision</th>
<th>Safety provision and preventive measures</th>
<th>Obtaining advice from the health sector about:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Site specific health hazards, General health status of local communities, Ten most common causes of morbidity and mortality, Location and functioning of health services</td>
<td>Access to health services</td>
<td>Settlement siting</td>
<td>Disease foci, vector biology</td>
</tr>
<tr>
<td>Planning and design</td>
<td>Improve routine health service surveillance by: retraining, health information system, laboratory services</td>
<td>Health center, Trained personnel, Drug supply, Equipment maintenance, Housing for health workers, Casualty/emergency unit</td>
<td>OHS planning, traffic routing, environmental management</td>
<td>Communicable disease control, environmental management for vector control, environmental manipulation, Environmental health</td>
</tr>
<tr>
<td>Construction</td>
<td>OHS monitoring, Environmental health: water supply, sanitary system, Drug supply, Vector monitoring</td>
<td>STD clinic, health training, casualty/emergency unit, vector and other communicable disease control</td>
<td>Safety measures consistent with DMC economy, OHS training, Traffic routing</td>
<td>Communicable disease control, Environmental health</td>
</tr>
<tr>
<td>Operation</td>
<td>Routine medical examination, Action oriented disease trend analysis, Child growth monitoring, OHS monitoring, Infant mortality monitoring, Vector monitoring, Casualty rates</td>
<td>Health education, immunization, obstetrics, training traditional health workers, food supplementation program, casualty/emergency unit, access to health service outside working hours, vector and other communicable disease control</td>
<td>OHS implementation environmental management</td>
<td>Communicable disease control, environmental management for vector control, environmental manipulation, Environmental health, Human behavior modification</td>
</tr>
<tr>
<td>Opportunities for Project enhancement</td>
<td>Health information system, Diagnostic/laboratory services</td>
<td>Healthy workforce is more productive and vice versa</td>
<td>Safer working methods, training, injury compensation</td>
<td>Intersectoral collaboration</td>
</tr>
</tbody>
</table>
1. **Safeguards**

   Where the community is exposed to a hazard as a result of occupation, mitigation may be achieved primarily by occupational safety measures and continuous health education. Where the community is exposed through its location, mitigation may be achieved primarily by reducing the hazard or relocation.

   Environmental management for vector control is an example of a mitigation where project design is seminal.

2. **Monitoring and Surveillance**

   There is a need for health and safety monitoring in development projects, especially in cases where the health risk cannot safely be forecast. However, it is not always clear what minimum health indicators should be measured. The health service do not usually have the resources to undertake surveillance. There are problems of enforcement and there may be no institutional mechanisms able to react to changing health risks at the project level.

   There is frequently a seasonal pattern to morbidity and mortality.

   A distinction may be drawn between the monitoring of hazardous factors in the environment and the monitoring of human health. The link between the two is the degree of human exposure.

   Environmental health monitoring systems are available to monitor water quality and hazardous discharges in air, water and solid waste and food safety. The WHO Western Pacific Regional Center for the Promotion of Environmental Planning and Applied Studies (PEPAS), can provide information, consultants and training services. The center is based in Kuala Lumpur. Entomological services, based in Communicable Disease Control departments of the Ministry of Health, monitor the distribution and abundance of disease vectors.

   The monitoring/surveillance of human health is the role of epidemiology. WHO (1989) have published a *Manual of Epidemiology for District Health Management* which is of considerable assistance to the non-health specialist.

   Surveillance is sometimes defined as systematic measurement of variables and processes for the purpose of establishing a time trend.
Monitoring, by contrast, is collecting data for analysis and action. Routine government health sector surveillance data is unlikely to be sufficiently accurate, sensitive or to have the coverage needed to indicate changes in health risk associated with a specific development project. Further, the linkage between the project and community health may be so indirect that health change cannot be attributed to the project. It may be necessary to commission special surveys.

There may be a need for proxy (or surrogate) health indicators. A sewerage project might measure the sewerage discharge. A drainage project might monitor the biting density of the common mosquito, *Culex quinquefasciatus*, as an indicator of both drainage obstruction and filariasis transmission potential.

Monitoring may only require simple field observation.

For non-communicable disease, it may be easier to monitor the concentration of a contaminant than to monitor changes in human health. Further, health risk management requires control of the contaminant at source. The health changes associated with the contaminant may be acute or chronic. Long latency periods are possible. In either case, health monitoring is beset by problems of ethics, random error, diagnostic limitations, non-linear dose-response curves, and synergistic effects of other contaminants.

Limitations of health sector data need to be considered and actions formulated to ensure that they match the project requirements. See Appendix 4.

3. **Health service preparedness**

The Project Officer should inform the health sector of the project plan. If a large influx of formal or informal settlers is expected then the health sector will require time to construct additional health centers, train personnel, obtain drug supplies and negotiate an increased budget. There is often an implicit assumption that the health service has the prior capacity, within its existing resources, to cope with any effects that may occur. This is unrealistic.
4. Environmental management

Agricultural development and infrastructure projects, in particular, provide an opportunity for vector-borne disease control through environmental management. Environmental management for vector control consists of deliberate alteration of the environment, environmental factors or interactions between people and the environment designed to limit vector breeding, survival or human contact. The environment includes soil, water, vegetation and urban and rural settlements. The environmental factors include microclimate, chemical composition and vector behavior. WHO’s Environmental Management for Vector Control summarizes this as follows.

(i) Permanent modification to the environment to inhibit vector breeding.
(ii) Repetitive actions, such as weed removal, to inhibit vector breeding.
(iii) Changes in human behavior and habitation which reduce breeding or exposure.

PEEM advocates mitigation measures such as the following.

- Drainage of urban and rural settlements and irrigation systems;
- alteration of river, reservoir and other water impoundment levels by sluicing and flushing;
- alteration of water salinity;
- removal of favorable and planting of unfavorable vegetation for vector breeding;
- changing conditions of exposure to sunlight and shade;
- land filling and levelling;
- alternate flooding and drying of rice fields;
- destruction of water-filled containers; screening of cisterns;
- improvements in sanitation, sewerage and solid waste management systems;
- siting human settlements 2km or more from vector sources;
- land zonation;
- using livestock as diversionary hosts;
- using bednets and house screens;
- management of irrigation water;
 Avoidance of infested water for laundry, bathing or recreation.

Example

Resettlement sites could be located at least 2km from vector breeding sites, such as the forest margin. Irrigation ditches could be self-draining when not in use. A proportion of water taxes could be retained under local control and used for project maintenance. Foot-bridges could be provided where schistosomiasis vectors are present. Rice cultivation could be intensive and synchronous to inhibit vectors. Water storage jars could be fitted with tight lids. Intermittent piped water supply could be avoided. Solid waste could be prevented from collecting rainwater or blocking drains. Septic tanks could be properly sealed. Downstream sections of dammed rivers could be regularly flushed.

Many of these measures cannot easily be incorporated in project design or operation unless previously identified through health impact assessment. Environmental management requires collaboration at all levels between different public sectors, the pooling of expertise and the involvement of the community.
# APPENDIXES TO GUIDELINES FOR
THE HEALTH IMPACT ASSESSMENT OF DEVELOPMENT PROJECTS

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</table>
APPENDIX 1

SUMMARY OF EXISTING BANK GUIDELINES

As a precursor to the preparation of the Health Impact Guidelines, the existing environmental guidelines of ADB were reviewed. References to health, safety and disease were located in discussions of three project stages: planning and design, construction and operation. The following tables provide an overview. The project monitoring database was also analysed. Out of a total of 469 projects, there were references as follows: health, 47; safety, 34; disease, 11.
## Summary

### Appendix 1

<table>
<thead>
<tr>
<th>Development Categories</th>
<th>Planning and Design</th>
<th>Construction</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation</td>
<td>Use of agricultural chemicals; selection of pesticides</td>
<td>Worker accidents, sanitation disease hazards, insect vector disease hazards, hazardous materials handling, dust, odors, fumes, explosion/fire, hazards/hazardous material spills, noise/vibration hazards, quarrying/blasting hazards, water pollution hazards</td>
<td>Water-oriented disease hazards; toxic chemical hazards; fertilizer runoff hazards</td>
</tr>
<tr>
<td>Fisheries and Aquaculture</td>
<td></td>
<td>Worker accidents, sanitation disease hazards, insect vector disease hazards, hazardous materials handling, dust, odors, fumes, explosion/fire, hazards/hazardous material spills, noise/vibration hazards, quarrying/blasting hazards, water pollution hazards</td>
<td></td>
</tr>
<tr>
<td>Watershed Development</td>
<td>Construction hazards; insect vector diseases</td>
<td></td>
<td>Nutrition and health; introduction of diseases</td>
</tr>
<tr>
<td>Forestry</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Land Clearing and Rehabilitation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coastal Zone Development</td>
<td>Worker accidents, sanitation disease hazards, insect vector disease hazards, hazardous materials handling, dust, odors, fumes, explosion/fire, hazards/hazardous material spills, noise/vibration hazards, quarrying/blasting hazards, water pollution hazards</td>
<td></td>
<td>Downstream water quality, insect vector disease hazards</td>
</tr>
<tr>
<td>Dams and Reservoirs</td>
<td>Worker accidents, sanitation disease hazards, insect vector disease hazards, hazardous materials handling, dust, odors, fumes, explosion/fire, hazards/hazardous material spills, noise/vibration hazards, quarrying/blasting hazards, water pollution hazards</td>
<td></td>
<td>Occupational safety and health programs</td>
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<tr>
<td>Thermal Power</td>
<td>Noise, occupational safety and health, hazardous spills, fires, explosions</td>
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</tr>
<tr>
<td>Industries</td>
<td>Liquid, gaseous and solid waste emissions, noise and vibrations</td>
<td>Nuisances/hazards to nearby residents and properties occupational health and safety programs</td>
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<tr>
<td>Development Categories</td>
<td>Planning and Design</td>
<td>Construction</td>
<td>Operation</td>
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</tr>
<tr>
<td>Fertilizer Manufacture</td>
<td>Water pollution control, types of waste discharge including pathogens, air pollution, solid waste disposal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mining and Mineral Processing</td>
<td>Occupational health and safety planning and its funding, pollution from spoils deposition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cement Manufacturing Plants</td>
<td>Occupational health inadequacies, cement dust, explosion hazards, water pollution, occupational health</td>
<td>Worker accidents, sanitation disease hazards, insect vector disease hazards, hazardous materials handling, dust, odors, fumes, explosion/fire, hazards/hazardous material spills, noise/vibration hazards, quarrying/blasting hazards, water pollution hazards</td>
<td></td>
</tr>
<tr>
<td>Power Transmission Lines</td>
<td>Explosion, fire, hazardous spills, workers’ health and safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil/Gas Distribution Lines</td>
<td>Inadequate provision for worker health and safety</td>
<td>Inadequate provisions for housing, communicable disease control provisions especially malaria, fires and explosions</td>
<td>Noise and vibration disturbances, airport wastes/pollution runoff, accidents, fires, hazardous materials spills</td>
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<td>Airports</td>
<td></td>
<td></td>
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<tr>
<td>Highway and Road Projects</td>
<td>Disposal of sanitary wastes for highway toilet facilities</td>
<td></td>
<td>Inadequate in-harbor facilities for managing various waste from shore/ship facilities, excessive noise from harbor activities</td>
</tr>
</tbody>
</table>
### Manual Chapters

**Vol. 1 - Operational Policies and Procedures**

**Sections Where Health Was Mentioned**

- **under Human Settlements**: amenities of integrated rural settlement schemes are jobs, housing, water supply, health services, etc.
- **under Natural Environmental Hazards**: Projects such as village water supply, malaria, and schistosomiasis control fall into this category. This type of project, due to inherent institutional problems, tends to be somewhat risky but could nevertheless become an increasingly important element of the Bank's lending program.
- **under Scope**: Role of women in education, health, nutrition, domestic water supply, urban low-cost housing.
- **under Section 25-26**: provision of health facilities and equipment.

**Vol. 2 - Project Processing and Administration**

**OM Section 80**: Health and Population Sector

- Upgrading of existing facilities and building new facilities, ranging from small rural clinics to large hospitals; provision of equipment and supplies and support, including repair and maintenance; training of paramedical and medical personnel and community health and population workers and management training and institutional development.
- **under Needs and Priorities**: High population densities, substandard housing, poor hygiene and environmental deterioration continue to characterize the populations of many DMCs. Nutritional diseases (e.g., anemia, protein/calorie deficiency, etc.) and communicable diseases (e.g., respiratory and gastrointestinal infections, malaria, etc.) are widely prevalent in DMCs, even though these diseases are preventable. Children under five and women in reproductive age, particularly in the lower income strata, are very prone to diseases.

**Vol. 3 - Sector Policies and Practices**

**under Agriculture and Rural Development**: Greater attention should also be given in rural development projects to extension services, activities of rural women, the promotion of rural industries and enterprises, and health, nutrition and family planning.

- Adequate public services in the fields of health, education, water supply, etc. are essential for the sustained development of rural areas.
- The Bank will continue to ensure that poverty alleviation is given high priority within its projects and programs — and that pertinent design criteria with respect to environmental and public health aspects are taken into account.

**OM Section 21 - Environmental Considerations in Bank Operations**

- Criteria for categorization of projects are provided as well as environmental assessment procedures to be followed in each case.

- **Category A**: the scale and type of predicted adverse environmental impacts necessitates an EIA (examples: agricultural projects envisaging large scale application of pesticides, resettlement of indigenous and vector-control communities, etc.)
- **Category B**: adverse environmental impacts expected to be lesser than under Category A requiring; nevertheless, an IEE which, in certain cases, may still be followed by an EIA (e.g., health projects with a waste disposal scheme)
- **Category C**: environmental assessment is not normally required (e.g., education projects).
APPENDIX 2 REVIEW OF HEALTH IMPACT ASSESSMENT

Health impact assessment procedures have evolved independently in several development sectors such as: irrigated agriculture, multipurpose reservoirs, water supply and chemical manufacture. The methods and procedures used and the problems encountered share many similarities. There are additional similarities to methods and procedures used in environmental impact assessment and to methods used more generally to evaluate externally funded projects (OECD, 1986).

In the water supply and sanitation sector, WHO has published procedures for analysing non-functioning or under-utilized systems and for evaluating the positive health impacts of fully functioning systems (WHO, 1983a; WHO, 1983b). In this sector health impacts generally refer to the intended health improvements which are assumed to derive from safe water supply and sanitation. In the Bank, project officers of the water supply/sanitation sector are well aware of many of the health issues associated with such development. There is, however, no systematic compilation of project design features which minimize or mitigate health risks. Consequently, it is difficult to distinguish the health engineering considerations which are well-known from those which are not well-known and should be included here.

One important group of health risks, the vector-borne diseases, have received considerable attention in development sectors associated with water resources, such as irrigation and reservoirs. There have been many reviews (Oomen, et al., 1988; Service, 1989). Such developments change the distribution and flow of surface waters, creating a favourable habitat for vector breeding. Human exposure to biting insects or contaminated waters provide the conditions necessary for an increased health risk. Expensive mitigation measures take the form of vector control through chemical application or environmental modification. In recognition of such increasing health risks a joint WHO/FAO/UNEP/UNCHS Panel of Experts on Environmental Management (PEEM) was formed in 1981. The panel members were aware that an important component of environmental management occurred at the design stage. Decisions about infrastructure, location and resettlement could help reduce vector populations or prevent exposure. This, in turn, would require a health impact assessment procedure. The procedure was published as Guidelines for Forecasting the Vector-borne Disease Implications of Water Resources Development (Birley, 1991).
It covered the sub-sectors of irrigated agriculture and multipurpose reservoirs and assisted the user to identify:

- the specific vector-borne disease hazards which occur regionally and in different habitats;
- the vulnerable communities;
- the capabilities of the health service to monitor, safeguard and mitigate.

These three components of the assessment were then combined into a statement of health risk.

Although the distinction between health hazard and health risk is well established in the chemical sector, it has not been in common use elsewhere. Birley (1991) was concerned with assessing the risks associated with vector-borne disease hazards in the water resource development sector.

WHO recently completed a review of the impact of development policy on health (Cooper Weil, et al., 1990). The review examined the health hazards associated with macroeconomic policy, agriculture, industry, energy and housing.

In the chemical industry sector there are procedures for determining modes of failure and the associated health hazards. There are two main issues:

- poisoning by routine or accidental exposure to toxic chemicals;
- traumatic injury from fire, explosion, radiation and corrosive action.

Over 60,000 chemicals are in common use and adequate information about toxicity and reactivity is not available for all of them. A meeting in 1986 established principles and objectives for health and safety assessments (WHO, 1987). Health impact assessment was viewed as a component of environmental impact assessment (EIA), already a well-established procedure. A programme of work was outlined to transfer knowledge and encourage debate to meet the perceived needs for health impact assessment. The meeting also reviewed the experiences of thirteen assessments of chemical plants spanning the period 1973-1983. A number of methodological issues were discussed that can be adapted to health impact assessments in other sectors. The three main tasks of
health impact assessment were listed as: identification of hazard, interpretation of health risk and risk management.

A Bank paper describes Environmental Risk Assessment (ERA), with emphasis on the hazards to human health from chemicals used or produced in industrial projects (ADB, 1990). The paper is primarily concerned with discrete and relatively rare events such as the unplanned release of toxic and reactive substances. The risks are effectively considered to be zero before construction commences. It tabulates impact frequency against impact severity. Risk is defined as the probability that an identified hazard will cause harm of a specific severity. For example, there could be $10^{-7}$ events per year in which the number of fatalities exceeds 1000. ERA is viewed as a component of Environmental Impact Assessment (EIA). EIA identifies the hazards and the uncertainty; the more detailed process of ERA then replaces uncertainty by risk estimates. The normal outputs of EIA are viewed as risks with a high probability and an obvious need for mitigation. The Bank study contains many features which can be applied to a general process of health impact assessment. These include hazard and risk, screening, scoping, setting terms of reference and risk management.

A recent report advocated rapid assessment for identifying environmental and health hazards in irrigation schemes. A set of vector-borne disease hazards were identified and a simple questionnaire was devised to determine whether the adverse effects (health risks) appeared sufficiently serious to warrant the project manager seeking specialist advice (Bolton et al., 1990).

The Bank has been instrumental in establishing and strengthening environmental protection agencies in DMCs, under Technical Assistance agreements (TAs). These agencies are one of several with a role in safeguarding public health. The most long established agencies are within the health sector itself. Other agencies include the Ministry of Manpower, or Labour, which has a responsibility for occupational health and safety. The Bank recognises, through its EIA procedure, the role of such agencies in safeguarding, mitigating and monitoring the environmental impacts of development projects.
References


WHO. Maximising Benefits to Health ...An appraisal methodology for water supply and sanitation projects (ETS/83.7). World Health Organisation, 1983a.


APPENDIX 3 SCREENING FOR HEALTH HAZARDS

In order to screen a project for health hazards, the Bank Officer requires a summary of the health hazards associated with each development sub-sector. Appendixes 5-13 provide such information. Appendix 3 contains summary tables for the following sub-sectors.

Irrigation  Foresty  Dams and Reservoirs  Thermal Power  Energy distribution  Highways and Roads  Urban Development  Fisheries and Aquaculture  Industrial sector, including fertilizer and cement manufacture  Watershed Development  Land Clearing and Rehabilitation  Coastal Zone Development  Mining and Mineral Processing  Airports  Ports and Harbours

There is insufficient information, at present, to prioritise the associated health hazards.

<table>
<thead>
<tr>
<th>Project stage</th>
<th>Health Hazard</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Vector-borne disease</td>
<td>Proliferation of vectors</td>
</tr>
<tr>
<td></td>
<td>Water-borne disease</td>
<td>Domestic water supply contamination</td>
</tr>
<tr>
<td></td>
<td>Malnutrition</td>
<td>Loss of subsistence crops</td>
</tr>
<tr>
<td></td>
<td>Injuries</td>
<td>Flooods</td>
</tr>
<tr>
<td>Planning and Design</td>
<td>Poisoning</td>
<td>Agrochemicals</td>
</tr>
<tr>
<td></td>
<td>Water-borne disease</td>
<td>Sanitary waste disposal</td>
</tr>
<tr>
<td>Construction</td>
<td>Poisoning, Injury</td>
<td>Inadequate occupational safety measures</td>
</tr>
<tr>
<td></td>
<td>Communicable disease associated with poor living conditions</td>
<td>Poor sanitation, poor water supply, poor food hygiene</td>
</tr>
<tr>
<td></td>
<td>STDs</td>
<td>Labour camps</td>
</tr>
<tr>
<td>Operation</td>
<td>Communicable disease associated with poor living conditions</td>
<td>Poor sanitation, poor water supply, poor food hygiene</td>
</tr>
<tr>
<td></td>
<td>Poisoning</td>
<td>Misuse of agrochemicals</td>
</tr>
<tr>
<td></td>
<td>Vector-borne diseases</td>
<td>Creation of vector habitats, lack of maintenance and lack of protection measures</td>
</tr>
</tbody>
</table>
### Industry: Screening for Health Hazards (including fertilizer and cement manufacture)

<table>
<thead>
<tr>
<th>Project stage</th>
<th>Health Hazard</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Poisoning</td>
<td>Pollution</td>
</tr>
<tr>
<td></td>
<td>Injury</td>
<td>Explosion</td>
</tr>
<tr>
<td></td>
<td>Vector-borne disease</td>
<td>Endemic disease foci</td>
</tr>
<tr>
<td>Planning and Design</td>
<td>Poisoning, Injury</td>
<td>Inadequate occupational safety measures and pollution control, hazardous waste disposal, zoning</td>
</tr>
<tr>
<td>Construction</td>
<td>Poisoning, Injury</td>
<td>Inadequate occupational safety measures</td>
</tr>
<tr>
<td>Operation</td>
<td>Poisoning, injury, deafness, respiratory disease, miscarriage, fetal deformity, cancer</td>
<td>Inadequate occupational safety measures and pollution control, hazardous waste disposal, catastrophic accidents</td>
</tr>
</tbody>
</table>

### Fisheries and Aquaculture: Screening for Health Hazards

<table>
<thead>
<tr>
<th>Project stage</th>
<th>Health Hazard</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Food Poisoning</td>
<td>Pollution, algal blooms</td>
</tr>
<tr>
<td></td>
<td>Injury</td>
<td>Storm and flood</td>
</tr>
<tr>
<td></td>
<td>Parasitic disease</td>
<td>Endemic disease foci</td>
</tr>
<tr>
<td>Planning and Design</td>
<td>Communicable diseases associated with excreta</td>
<td>Use of fresh excreta as fertilizer</td>
</tr>
<tr>
<td>Construction</td>
<td>Poisoning, Injury</td>
<td>Inadequate occupational safety measures</td>
</tr>
<tr>
<td></td>
<td>Communicable disease associated with poor living conditions</td>
<td>Poor sanitation, poor water supply, poor food hygiene</td>
</tr>
<tr>
<td>Operation</td>
<td>Injury</td>
<td>Storm and flood</td>
</tr>
<tr>
<td></td>
<td>Food Poisoning</td>
<td>Poor monitoring of water for pathogens and toxins</td>
</tr>
</tbody>
</table>
### Watershed Development: Screening for Health Hazards

<table>
<thead>
<tr>
<th>Project stage</th>
<th>Health Hazard</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Vector-borne disease</td>
<td>Endemic disease foci, resettlement</td>
</tr>
<tr>
<td></td>
<td>Malnutrition</td>
<td>Loss of common property resources, resettlement</td>
</tr>
<tr>
<td>Planning and Design</td>
<td>Vector-borne disease</td>
<td>Creation of vector habitats</td>
</tr>
<tr>
<td>Construction</td>
<td>Poisoning, Injury</td>
<td>Inadequate occupational safety measures</td>
</tr>
<tr>
<td></td>
<td>Communicable disease associated with poor living conditions</td>
<td>Poor sanitation, poor water supply, poor food hygiene</td>
</tr>
<tr>
<td></td>
<td>STDs</td>
<td>Labour camps</td>
</tr>
<tr>
<td></td>
<td>Vector-borne disease</td>
<td>Exposure to endemic foci</td>
</tr>
<tr>
<td>Operation</td>
<td>Communicable diseases associated with excreta</td>
<td>Upstream pollution</td>
</tr>
</tbody>
</table>

### Forestry: Screening for Health Hazards

**Including tea, rubber and fruit**

<table>
<thead>
<tr>
<th>Project stage</th>
<th>Health Hazard</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Malnutrition</td>
<td>Loss of common property resources</td>
</tr>
<tr>
<td></td>
<td>Injury</td>
<td>Insurgency</td>
</tr>
<tr>
<td></td>
<td>Vector-borne disease</td>
<td>Endemic disease foci</td>
</tr>
<tr>
<td>Planning and Design</td>
<td>Malnutrition, vector-borne diseases</td>
<td>Resettlement</td>
</tr>
<tr>
<td>Construction</td>
<td>Poisoning, Injury</td>
<td>Inadequate occupational safety measures</td>
</tr>
<tr>
<td></td>
<td>Communicable disease associated with poor living conditions</td>
<td>Poor sanitation, poor water supply, poor food hygiene</td>
</tr>
<tr>
<td></td>
<td>STDs</td>
<td>Labour camps</td>
</tr>
<tr>
<td>Operation</td>
<td>Injury</td>
<td>Inadequate occupational safety measures</td>
</tr>
<tr>
<td></td>
<td>Communicable disease</td>
<td>Poor sanitation in logging camps</td>
</tr>
<tr>
<td></td>
<td>Vector-borne diseases</td>
<td>Colonization of plantation by vectors</td>
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### Land Clearing and Rehabilitation: Screening for Health Hazards

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<thead>
<tr>
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<th>Health Hazard</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>Malnutrition</td>
<td>Loss of common property resources, esp. of women</td>
</tr>
<tr>
<td></td>
<td>Vector-borne disease</td>
<td>Endemic disease foci</td>
</tr>
<tr>
<td><strong>Planning and Design</strong></td>
<td>Malnutrition</td>
<td>Resettlement</td>
</tr>
<tr>
<td><strong>Construction</strong></td>
<td>Poisoning, Injury</td>
<td>Inadequate occupational safety measures</td>
</tr>
<tr>
<td></td>
<td>Communicable disease associated with poor living conditions</td>
<td>Poor sanitation, poor water supply, poor food hygiene</td>
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<tr>
<td></td>
<td>STDs</td>
<td>Labour camps</td>
</tr>
<tr>
<td></td>
<td>Vector-borne disease</td>
<td>Exposure to vectors in endemic disease foci</td>
</tr>
<tr>
<td><strong>Operation</strong></td>
<td>Vector-borne diseases</td>
<td>Creation of breeding sites</td>
</tr>
<tr>
<td></td>
<td>Respiratory disease</td>
<td>Dust</td>
</tr>
</tbody>
</table>

### Dams and Reservoirs: Screening for Health Hazards

<table>
<thead>
<tr>
<th>Project stage</th>
<th>Health Hazard</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>Malnutrition</td>
<td>Loss of common property resources, loss of irrigation water</td>
</tr>
<tr>
<td></td>
<td>Poisoning</td>
<td>Contamination of downstream waters</td>
</tr>
<tr>
<td></td>
<td>Vector-borne disease</td>
<td>Endemic disease foci, access to forested hinterlands</td>
</tr>
<tr>
<td><strong>Planning and Design</strong></td>
<td>Malnutrition, vector-borne disease, communicable disease associated with poor living conditions</td>
<td>Resettlement, access roads</td>
</tr>
<tr>
<td></td>
<td>Water-borne disease</td>
<td>Downstream river pollution</td>
</tr>
<tr>
<td><strong>Construction</strong></td>
<td>Poisoning, Injury</td>
<td>Inadequate occupational safety measures</td>
</tr>
<tr>
<td></td>
<td>Communicable disease associated with poor living conditions</td>
<td>Poor sanitation, poor water supply, poor food hygiene</td>
</tr>
<tr>
<td></td>
<td>STDs</td>
<td>Labour camps</td>
</tr>
<tr>
<td></td>
<td>Vector-borne disease</td>
<td>Exposure to vectors in endemic disease foci</td>
</tr>
<tr>
<td><strong>Operation</strong></td>
<td>Vector-borne diseases</td>
<td>Creation of breeding sites</td>
</tr>
<tr>
<td></td>
<td>Respiratory disease</td>
<td>Dust</td>
</tr>
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## Coastal Zone Development: Screening for Health Hazards

<table>
<thead>
<tr>
<th>Project stage</th>
<th>Health Hazard</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Malnutrition</td>
<td>Loss of common property resources by fisherfolk</td>
</tr>
<tr>
<td></td>
<td>Poisoning and excreta related disease</td>
<td>Water-based pollution</td>
</tr>
<tr>
<td>Planning and Design</td>
<td>Poisoning and excreta related disease</td>
<td>Effluent disposal</td>
</tr>
<tr>
<td>Construction</td>
<td>Poisoning, Injury, miscarriage</td>
<td>Inadequate occupational safety measures</td>
</tr>
<tr>
<td></td>
<td>Communicable disease associated with poor living conditions</td>
<td>Poor sanitation, poor water supply, poor food hygiene</td>
</tr>
<tr>
<td></td>
<td>STDs</td>
<td>Labour camps</td>
</tr>
<tr>
<td>Operation</td>
<td>Injury</td>
<td>Storm and flood</td>
</tr>
<tr>
<td></td>
<td>Poisoning and excreta related disease</td>
<td>Pollution</td>
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</table>

## Thermal Power: Screening for Health Hazards

See also mining

<table>
<thead>
<tr>
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<th>Health Hazard</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Injury</td>
<td>Fire, explosion, road haulage of fuel</td>
</tr>
<tr>
<td></td>
<td>Respiratory disease</td>
<td>Air pollution</td>
</tr>
<tr>
<td></td>
<td>Excreta related disease</td>
<td>Use of contaminated water supplies following loss of water sources</td>
</tr>
<tr>
<td>Planning and Design</td>
<td>Injury</td>
<td>Traffic routing</td>
</tr>
<tr>
<td></td>
<td>Heavy metal poisoning</td>
<td>Fly ash disposal, leachates</td>
</tr>
<tr>
<td>Construction</td>
<td>Poisoning, Injury</td>
<td>Inadequate occupational safety measures</td>
</tr>
<tr>
<td></td>
<td>Communicable disease associated with poor living conditions</td>
<td>Poor sanitation, poor water supply, poor food hygiene</td>
</tr>
<tr>
<td></td>
<td>STDs</td>
<td>Labour camps</td>
</tr>
<tr>
<td>Operation</td>
<td>Respiratory disease, eye disease, injury, cancers, deafness</td>
<td>Air pollution, fly ash, Explosion, noise and vibration</td>
</tr>
</tbody>
</table>
### Mining and Mineral Processing: Screening for Health Hazards

<table>
<thead>
<tr>
<th>Project stage</th>
<th>Health Hazard</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Malnutrition</td>
<td>Loss of common property resources</td>
</tr>
<tr>
<td></td>
<td>Vector-borne disease</td>
<td>Endemic disease foci</td>
</tr>
<tr>
<td></td>
<td>Poisoning</td>
<td>Pollution from spoil deposits</td>
</tr>
<tr>
<td>Planning and</td>
<td>Dust-induced lung disease</td>
<td>Excessive dust</td>
</tr>
<tr>
<td>Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>Poisoning, Injury</td>
<td>Inadequate occupational safety measures</td>
</tr>
<tr>
<td></td>
<td>Communicable disease</td>
<td>Poor sanitation, poor water supply, poor food</td>
</tr>
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<td></td>
<td>associated with poor living</td>
<td>hygiene</td>
</tr>
<tr>
<td></td>
<td>conditions</td>
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<tr>
<td></td>
<td>STDs</td>
<td>Labour camps</td>
</tr>
<tr>
<td></td>
<td>Vector-borne disease</td>
<td>Exposure to vectors in endemic disease foci</td>
</tr>
<tr>
<td>Operation</td>
<td>Dust-induced lung disease,</td>
<td>Poor protection from dust, poor ventilation</td>
</tr>
<tr>
<td></td>
<td>infectious respiratory disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>STDs</td>
<td>Labour camps, unaccustomed wealth, poor health</td>
</tr>
<tr>
<td></td>
<td>Injury, poisoning, deafness,</td>
<td>Poor occupational safety, abandoned mine</td>
</tr>
<tr>
<td></td>
<td>drowning</td>
<td>workings, dam failure</td>
</tr>
</tbody>
</table>

### Electricity, oil and gas distribution lines: Screening for Health Hazards

<table>
<thead>
<tr>
<th>Project stage</th>
<th>Health Hazard</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Vector-borne disease</td>
<td>Endemic disease foci</td>
</tr>
<tr>
<td>Planning and</td>
<td>Injury</td>
<td>Zoning</td>
</tr>
<tr>
<td>Design</td>
<td>Vector-borne disease</td>
<td>Access roads</td>
</tr>
<tr>
<td>Construction</td>
<td>Poisoning, Injury</td>
<td>Inadequate occupational safety measures</td>
</tr>
<tr>
<td></td>
<td>Communicable disease</td>
<td>Poor sanitation, poor water supply, poor food</td>
</tr>
<tr>
<td></td>
<td>associated with poor living</td>
<td>hygiene</td>
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<tr>
<td></td>
<td>conditions</td>
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<tr>
<td></td>
<td>STDs</td>
<td>Labour camps</td>
</tr>
<tr>
<td></td>
<td>Vector-borne disease</td>
<td>Exposure to vectors in endemic disease foci</td>
</tr>
<tr>
<td>Operation</td>
<td>Injury such as electrocution</td>
<td>Fuel leaks, poor maintenance, illegal connection</td>
</tr>
<tr>
<td></td>
<td>and explosion</td>
<td></td>
</tr>
</tbody>
</table>
### Airports: Screening for Health Hazards

<table>
<thead>
<tr>
<th>Project stage</th>
<th>Health Hazard</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Malnutrition</td>
<td>Resettlement</td>
</tr>
<tr>
<td>Planning and Design</td>
<td>Injury</td>
<td>Crashes</td>
</tr>
<tr>
<td>Construction</td>
<td>Poisoning, Injury</td>
<td>Inadequate occupational safety measures</td>
</tr>
<tr>
<td>Operation</td>
<td>Vector-borne and other communicable diseases</td>
<td>Accidental introduction of vectors and pathogens</td>
</tr>
<tr>
<td></td>
<td>Injury</td>
<td>Poor maintenance</td>
</tr>
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</table>

### Highways and Roads: Screening for Health Hazards

<table>
<thead>
<tr>
<th>Project stage</th>
<th>Health Hazard</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Vector-borne disease</td>
<td>Endemic disease foci</td>
</tr>
<tr>
<td></td>
<td>Malnutrition</td>
<td>Access to forested hinterlands</td>
</tr>
<tr>
<td></td>
<td>Loss of common property resources, increase in land values, change of livelihood</td>
<td></td>
</tr>
<tr>
<td>Planning and Design</td>
<td>Injury</td>
<td>Roads with poor safety features</td>
</tr>
<tr>
<td></td>
<td>Communicable disease</td>
<td>Borrow pits, pooling, interrupted surface flows</td>
</tr>
<tr>
<td>Construction</td>
<td>Poisoning, Injury</td>
<td>Inadequate occupational safety measures</td>
</tr>
<tr>
<td></td>
<td>Communicable disease associated with poor living conditions</td>
<td>Poor sanitation, poor water supply, poor food hygiene</td>
</tr>
<tr>
<td></td>
<td>STDs</td>
<td>Labour camps</td>
</tr>
<tr>
<td></td>
<td>Vector-borne disease</td>
<td>Exposure to vectors in endemic disease foci</td>
</tr>
<tr>
<td>Operation</td>
<td>Vector-borne diseases</td>
<td>Roadside squaters using surface water supplies</td>
</tr>
<tr>
<td></td>
<td>Communicable disease associated with poor living conditions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Respiratory disease</td>
<td>Dust</td>
</tr>
<tr>
<td></td>
<td>Injury</td>
<td>Poor vehicle and road maintenance, poor traffic regulation, poor driver education, increasing vehicle density</td>
</tr>
<tr>
<td></td>
<td>STDs</td>
<td>Long distance truck drivers</td>
</tr>
</tbody>
</table>
## Ports and Harbours: Screening for Health Hazards

<table>
<thead>
<tr>
<th>Project stage</th>
<th>Health Hazard</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Malnutrition</td>
<td>Loss of communal fisheries</td>
</tr>
<tr>
<td></td>
<td>Poisoning</td>
<td>Leakage of hazardous materials during transit</td>
</tr>
<tr>
<td></td>
<td>Excreta related diseases</td>
<td>Poor waste disposal facilities</td>
</tr>
<tr>
<td>Construction</td>
<td>Poisoning, Injury</td>
<td>Inadequate occupational safety measures</td>
</tr>
<tr>
<td></td>
<td>Communicable disease associated with poor living conditions</td>
<td>Poor sanitation, poor water supply, poor food hygiene</td>
</tr>
<tr>
<td></td>
<td>STDs</td>
<td>Labour camps</td>
</tr>
<tr>
<td>Operation</td>
<td>Exotic communicable diseases, including bubonic plague</td>
<td>Accidental shipment of infected rodents, vectors or pathogens</td>
</tr>
<tr>
<td></td>
<td>STDs</td>
<td>Transit of single males</td>
</tr>
<tr>
<td></td>
<td>Injury</td>
<td>Poor operation and maintenance</td>
</tr>
</tbody>
</table>

## Urban Development: Screening for Health Hazards

<table>
<thead>
<tr>
<th>Project stage</th>
<th>Health Hazard</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Communicable disease associated with poor living conditions</td>
<td>Displacement through slum clearance, excreta disposal, water supply</td>
</tr>
<tr>
<td></td>
<td>Injury</td>
<td>Steep hillsides, flood-prone valleys, poor access to and for emergency services</td>
</tr>
<tr>
<td></td>
<td>Non-communicable disease</td>
<td>Pollution, hazardous waste, hazardous occupation</td>
</tr>
<tr>
<td>Planning and Design</td>
<td>Excreta-related disease, vector-borne disease</td>
<td>Water supply and sanitation problems</td>
</tr>
<tr>
<td></td>
<td>Injury</td>
<td>Traffic</td>
</tr>
<tr>
<td>Construction</td>
<td>Poisoning, Injury</td>
<td>Inadequate occupational safety measures</td>
</tr>
<tr>
<td></td>
<td>Communicable disease associated with poor living conditions</td>
<td>Poor sanitation, poor water supply, poor food hygiene</td>
</tr>
<tr>
<td>Operation</td>
<td>Vector-borne diseases</td>
<td>Blocked drainage, domestic water storage, solid waste management</td>
</tr>
<tr>
<td></td>
<td>Excreta-related disease</td>
<td></td>
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<td></td>
<td>Injury</td>
<td>Traffic</td>
</tr>
</tbody>
</table>
APPENDIX 4 AVAILABILITY OF HEALTH INFORMATION IN THE REGION

Contributed by the World Health Organization, Western Pacific Region

Upon this gifted age, in its dark hour
Rains from the sky a meteoric shower
Of facts - They lie unquestioned, uncombined,
Wisdom enough to leech us all of our ill
Is daily spun, but there exists no loom
To weave it into fabric  (Edna St. Vincent Millay)

A. Introduction

From a health sector perspective, health information systems have three major objectives:

- measure the health status of the population;
- account for the interventions and services rendered;
- rationalize the investment of human and financial resources in health systems operations.

Information systems play a vital role in enabling health system planners to make rational decisions about health development. These same systems are an important component of the information resources necessary to make similar decisions about development projects.

In the WHO Western Pacific Region and in other countries of the ASEAN area, substantial progress has been made in developing national health information systems. For the most part, countries are able to produce statistics on mortality, natality, morbidity and delivery of health services. However, the accuracy, timeliness and coverage of these data are subject to serious question. This document assesses general capacity to produce health data. It does not include inter-country comparisons, although there is great variability.

The selection of appropriate health indicators depends on the nature of the problem being considered. Common indicators include population
size, growth and distribution, mortality and cause of death, morbidity, availability and utilization of health facilities and services, and exposure to environmental pollutants and other recognized health hazards.

B. Population Statistics

Great variation exists in the periodicity of national census in the countries of the region. Available data may be 6 - 15 years old. Even in those countries where a census has been undertaken recently, the ability to obtain accurate estimates of population in small geographic areas (e.g., country, province, commune, district) is problematic. Projections are straight-lined for intercensal estimation and do not account for internal migration, emigration and serious under-reporting of natality and mortality. According to the Economic and Social Commission for Asia and the Pacific (ESCAP) over half of the countries in their coverage are unable to produce local population estimates by age, sex, urban/rural or other differentials.

C. Mortality Statistics

The registration and certification of death has been estimated to be under-reported by as much as 50%. The range of under-registration is from 18% in the Republic of Korea and Indonesia, to 68% in Viet Nam and Myanmar according to estimates by World Bank, UNESCO and UN Department of International Economic and Social Affairs. Less than half of the deaths are medically certified and cause thereby determined. Added to this is the serious deficiency in application of standards in applying a nomenclature for cause. Although in several countries in Asia the 9th Revision of the International Classification of Diseases (ICD) is maintained in use, essentially no training is provided in the education of physicians in using cause of death rules in certification processes. Maternal and child mortality in particular suffers from the absence of cause determination.

D. Morbidity Statistics

Morbidity data are derived from national reporting systems of events for which persons are hospitalized and notifiable communicable diseases in the population served by the health system. Much of the data emanating from hospitals suffers from an enumerator/ denominator problem of lack of knowledge of the population the events represent. Similarly, with communicable diseases data, the population is often unknown and, in addition, the cases reported are often "suspected" cases.
with little or no chance of denial or confirmation by laboratory support. Many other well-used and oft-quoted indicators related to institutional care such as the proportion of births greater or less than 2500 grams of weight are reported from only a few higher quality hospitals and then extrapolated to the entire population at severe risk as to validity.

E. Environmental Statistics

The responsibility for the formulation of plans and programmes in the area of environmental health falls outside the purview of the Ministries of Health in most ASEAN member countries. Indeed, environment, occupational and industrial health concerns are often spread across a broad range of institutes, centers, departments, agencies and organizations of government. The operation and maintenance of data systems on water, air and noise pollution, chemical and nuclear waste, food safety and accidents are likewise distributed widely. A number of these systems appear to have excellent coverage and timely data. Access to these data sources is, however, a serious problem. Confidentiality and permission often limit their wide use. Again, these systems suffer from problems related to national estimates without the capability to make good local estimates. Even in large cities, there may be major discrepancies in quality and definition between segments of the population or localities.

The review of national health information systems conducted in 1985 by WHO/Western Pacific Region revealed that almost all countries were involved in major health data activities. However, there was a tendency to view information as a free-standing item rather than as an element or tool for management of service activities. This view has led to the development of information systems as vertical activities emphasizing the collection of data at the periphery to meet the needs of central offices. This places a heavy burden of collecting and reporting on local level staff and generates data that has little relevance to their day-to-day activity and therefore little is obtained in meaningful local geographic or other detail. The limitation in the data is a direct result of the limitation in trained and experienced information system staff.
F. Summary

The disease-oriented approach to analysis of the health status of the population and the associated changes that might be brought about by different intervention strategies assumes that an adequate supply of data can provide the information needed to support health policy decisions. This purports to be the case in developing countries at the national level. There are serious problems, however, in carrying this approach to the district level because of a lack of trained staff capable of collecting and using health data at the local level. This is the level where developmental projects supported by the Bank would have their greatest impact on health.

There is a huge amount of data being collected and maintained in diverse national health institutions. Collection processes are becoming more sophisticated with the advent of the small powerful microcomputers and generalized software. Several developing countries are considering reorientation of their information systems to provide for improvements in the process of determining what data is needed, by whom, in what timeframe and for what purposes. These are positive steps.

There is a need to increase the numbers and training of appropriately assigned staff to use, interpret, disseminate, promote and manage data.
APPENDIX 5 CROSS-CUTTING HEALTH ISSUES

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There are several health issues that cut across a number of development activities and require separate attention.

A. Malaria

Malaria is a serious and growing problem throughout the region (Kondrashin & Rashid, 1987; Sharma & Kondrashin, 1991). There are two main kinds and they are present in varying proportions.

(i) *Falciparum malaria.* High mortality and morbidity rate; widespread drug resistance; high prevalence rates in forests and at the forest fringe. Drug resistance is so serious that in some areas there are no preventative or curative drugs which are still usable.

(ii) *Vivax malaria.* High morbidity rate; emerging but very limited drug resistance; requires additional treatment for a complete cure; low prevalence rates on open plains and some coastal areas.

Malaria is transmitted by some, but not all, species of mosquitoes (vectors).

In each country there are one or two main mosquito vectors and several other vectors of secondary importance. In high rainfall areas of former monsoon forest which are now open agricultural plains, there has been
considerable success at suppressing the vectors. This has occurred either by spraying or by eradication of breeding sites. Malaria remains a very serious problem in the forest, at the forest fringe and in tree crop plantations. Project location and design could be crucial. Settlements should be kept 2kms from the forest fringe or tree crop plantation.

□ Deforestation: the process itself may expose workers to malaria but transmission may cease on the open lands.

□ Reforestation: by tree crop plantations such as rubber, tea, fruit or timber, may reintroduce malaria vectors when shade trees become established.

Example

In Thailand one forest vector breeds in pools under deep forest shade and the other breeds in stream pools under moderate shade at the forest edge. Malaria incidence is associated with housing location and occupations which take people into the forest or into tree crop plantations during the night. Knowledge about the causes of malaria is very limited among seasonal migrant labourers.

In Malaysia the vector breeds in small sunlit streams and malaria incidence increases where trees are felled for rubber planting. Malaria is associated with land development rather than water development. The malaria risk is highest during the construction and early operation phases of a project, before the tree cover returns.

In the drier countries of Pakistan, India and parts of China, plus certain rice growing regions such as Java, the most important vector is associated with irrigation ditches, ricefields and ponds. Proper operation and management of irrigation projects is essential for malaria control. Groundwater control projects may have a beneficial effect on malaria but this is not proven. Pakistan and India are also relatively unique in having an urban malaria vector. It breeds in overhead tanks and other large containers of relatively clean water. Urban development projects in this region could affect its distribution.

In each country there are malaria control officers at national and district level who are informed about the local malaria vector. They will frequently not have the resources to control malaria unaided. The WHO
Regional Offices in New Delhi and Manila should be consulted for further information.

B. Nutrition

All development projects are likely to have an impact on the food security and nutritional status of people living within and near the project area. Some projects in the renewable natural resources category—such as irrigation, fisheries, crop storage—will have improvements in food security as their specific objective. Other projects—such as mining, rural water supply, road construction—could have (and have had) an impact through a variety of indirect and possibly unplanned mechanisms.

The effects of undernutrition include:

(i) Wasting. Can be caused by transitory and seasonal food shortages. Wasting indicates an acute deficit, an immediate risk of dying, and is measured as weight for height.

(ii) Stunting. Can be associated with chronic undernutrition. Stunting indicates household stress due to food insecurity, childhood infection or lack of child care. It indicates a long-term deficit and is measured as height for age.

(iii) Goitre, cretinism, skin diseases and anemia. Associated with low consumption of essential minerals.

(iv) Blindness. Associated with low consumption of essential vitamins.

(v) Low birth weight. Associated with maternal nutrition.

Stunting and wasting are easily measured and have been used as an indicator of project impact on children in impoverished communities. There are complex interactions between nutrition, infection, intoxication, behaviour and economics.

Especially vulnerable groups include young children and pregnant or lactating women. The household often cannot be considered as a unit when considering access to adequate food. Increased food production, such as rice, does not necessarily lead to improved nutritional status.

WHO’s A Guide to Nutritional Assessment discusses policy objectives, monitoring, evaluating and rapid assessment methods (Beghin, et al., 1988). The Guide is suitable for use down to the project level. It
emphasises the need to establish hypothetical causal models of a nutritional situation.

1. **Effect of development projects**

Development projects can have a detrimental effect on the nutritional status of vulnerable groups in many complex ways, including the following.

(i) **Food production.**

- Switch from food to cash crops;
- Crop establishment delays;
- Reduced production of minor crops;
- Reduced access to or use of home gardens.

(ii) **Food availability.**

- Poor market availability;
- Poor purchasing power;
- High market price;
- Reduced access to wild foods;
- Destruction of wild foods such as fisheries.

(iii) **Workload.**

- Reduced child care through increased weeding, labouring or fuel and water collection time.

(iv) **Infection.**

- Reduced utilization of food;
- Reduced productive labour.

(v) **Feeding practices.**

- Reduced breast feeding, early weaning, purchase of substitutes, leading to infantile diarrhea.
- Poor choice of food quality, poor food habits.
- Diversion of household income, changes in food entitlement;
- Excessive sale of food produced.
Example

In Papua New Guinea the effects of resettling agriculturalists and hunter-gatherers in a rubber growing area were studied amongst 3 ethnic groups. The income from cash crops was positively associated with the nutritional status and dietary energy intake of children in the area. In this project, the cash was used to buy foods providing more energy (rice) and protein (fish) than local subsistence crops. However, improvements in maternal nutritional status were associated with the amount of food grown in home gardens (Shack, et al., 1990). The important conclusion is that the combination of the availability of high quality foods, the income needed to buy them and the maintenance of home gardens resulted in improved nutritional status.

2. Checklist

☐ Will all the communities associated with the project have physical and economic access to adequate food at all times?

The following list of seven questions relating to agricultural projects provide more detail (IFAD, 1983). Does the project:

☐ Increase the income of "at risk" households?
☐ Reduce production of foods for home consumption?
☐ Induce an increase in food prices in the project area?
☐ Affect food availability and prices in the country?
☐ Affect adversely rural people in some years and some seasons?
☐ Cause changes in expenditure patterns and/or control of income?
☐ Lessen the time available to women for food preparation, child care and other household chores?

The checklists in the Bank’s Guidelines for Social Analysis of Development Projects (being revised) should also be consulted.
C. Labour Mobility

Development projects may cause or contribute to population growth and population movement (Gould & Woods, 1990).

Mobile populations are vulnerable to new health hazards. They include temporary labourers and resettlers. The accompanying table illustrates a more complete typography with examples of associated activities and health hazards (Prothero & Gould, 1984). Many different kinds of population movement may occur in response to a development project.

Economic development of plantations, mines and other industries have usually been accompanied by labour mobility. Temporary workers, drawn from a largely underdeveloped hinterland, are exposed to severe health hazards. These hazards are generally occupational, such as the exposure to dusts and toxic chemicals, or associated with poor living conditions. Tuberculosis, pneumoconioses and pneumonia are common (Giel & Van Luijk, 1967).

Economic activities, population mobility and examples of association with health hazards (After Prothero and Gould (Prothero, et al., 1984)).

<table>
<thead>
<tr>
<th>Circulation</th>
<th>Migration</th>
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<tr>
<td>Daily</td>
<td>Periodic</td>
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<td>Rural-Rural</td>
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<tr>
<td>Rural-Urban</td>
<td>Cultivating (1)</td>
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Key to Health Hazards

1) Contact with ecological zones (eg: vector-borne diseases).
2) Direct contact between different communities (eg: STDs, measles, poliomyelitis).
3) Physical stress (eg: fatigue, malnutrition).
4) Psychological stress (problems of adjustment, alcoholism).

Many labourers are single males who are separated from their families and communities. STD transmission is commonplace. Workers' accommodation is often intolerable, insecure and depressing (Hunt, 1989). The high price, legislation and poor quality of urban dwellings forces migrant workers to live apart from their families. One major
cause of heterosexual spread of HIV in Africa has been ascribed to the special prominence of labour mobility in that region (Hunt, 1989).

Example

The prevalence of STDs often increases during the harvesting season.

In one study, 94% of those infected with STDs were working more than 400 km from their native area (Verhagen & Gemert, 1972). In another study, half of STD patients came from the surrounding rural area and half were migrants (Bennett, 1962).

Increasingly, women are forming part of the migrating work force as rural demand for their labour decreases. They migrate to new industrial developments in the cities or to concentrations of male labour. Wage employment for women is often harder to obtain or poorer paid than for men (Browner, 1989). They are at risk from sexual harassment and rape and some, perhaps many, become sex workers. Others may be required to exchange sexual favours for food and accommodation. Young men may do the same.

Example

Female headed households are more likely to live in poverty, in substandard housing with unsafe drinking water and inadequate sewers and with insufficient income to eat a balanced diet (Browner, 1989).

Returning labourers may carry new communicable diseases to their place of origin, where health care facilities are frequently poor (Packard, 1989). This includes STDs that lead to female infertility (Raikes, 1989). They may have occupational diseases for which industry has failed to accept responsibility. The burden for their care falls on their families.

The hinterland itself may be a dependent labour reserve with declining agriculture, labour shortage, poor health care facilities and malnutrition. The burden of both agricultural production and care of dependents falls more heavily on the women who are left behind. Crop production may then shift to more easily grown but less nutritious staples; child care may
decline. Malnutrition and disease susceptibility may increase. The family may not be able to leave the impoverished land without losing their claim to it (Raikes, 1989). On the other hand, remittances from migrants may raise household incomes and provide access to a wider range of food.

Migrant labourers may choose to remain when a construction project is completed. They may create new settlements without infrastructure, live in unsanitary conditions and contribute to disputes over land and common property resources (Odingo, 1979).

D. Resettlement

Two important forms of resettlement are: settlement of new lands to achieve a public good; displacement to resettlement as part of the attainment of a public good. In the former case the settled community represents a productive resource and will receive support. In the latter case the community are viewed as an obstacle to development that may receive either negligible or inappropriate support (Colson, 1971; Roundy, 1989). Health hazards are rarely seen as a major constraint to resettlement success compared with problems of administration or agricultural planning.

Example

Indigenous people displaced by the OK Tedi mine in Papua New Guinea have become increasingly reliant on imported rice and tinned fish. Traditional subsistence food growing and trading has been eroded. Alcohol abuse has become common and women's status has been lowered (Hyndeman, 1988).

Vector-borne communicable diseases are often significant in resettlement schemes because of increased exposure or the creation of new vector-breeding sites. Careful planning and siting can do much to mitigate this risk.

Resettlement is an enormously stressful experience. Stress-related illness is a likely outcome. Medical staff should be alerted.
Example

Resettled communities in Southeast Asia have established subsistence farm plots within the forest reserve. The prevalence of malaria has increased as it is largely confined to the forest and forest fringe.

Communities displaced to resettlement face formidable obstacles with profound health consequences. Often no compensation has been provided. In other cases, compensation has consisted of agricultural development. This usually involves a shift from subsistence to cash cropping that the community may not accept. See also Agriculture (Appendix 9).

Resettlement projects are also planned as a response to spontaneous population migrations, perhaps as a result of civil disturbance. In this case new infrastructure may accelerate spontaneous migration into the area.

E. Construction

Many development projects include a construction phase. Large scale construction requires migrant labour and may take place in remote rural areas. Small scale construction may use a local labour force, subcontracted through the informal sector.

1. Communicable Disease

Construction workers are subject to a range of communicable diseases as a result of migration from different environments or bush clearance activities. Construction camps are notoriously insanitary and numerous camp followers provide additional hazards of STD transmission.
Malaria outbreaks were avoided during the construction of the following projects by careful planning: the Tungabhadra dam in Andhra Pradesh, India; the hydroelectric plant at Balbina, Amazonas; and the building of the railway from Cuiaba to Porto Velho, Brazil (Rao, et al., 1946; Taui, 1986).

By contrast, in the following projects there were no provisions for malaria control and malaria was a problem: the hydroelectric plant at Tucurui, Brazil; the mining operations at Itaituba and Madeira river, Brazil; the Sakkur barrage in Pakistan; and the Mettur dam in India (Brown & Deom, 1973).

2. Occupational Safety

Occupational health and safety are key issues. Workloads are heavy and there is often exposure to unsafe noise levels, dust, toxic chemicals, gases, vibration, flammable materials and high temperatures. Much morbidity is work-related rather than occupational: associated with stress, long hours, low pay, poor food, smoking and drinking.

Example

In the UK construction industry there are 10 fatalities per 100,000 employees per year. The ratio of major to fatal injuries is 27. Cancers, respiratory and circulatory diseases are more common than in other workers (Snashall, 1990).

Occupational diseases of construction workers includes "white finger". This follows from extended periods of holding vibrating equipment.

Construction workers are at risk of poisoning. Lead poisoning was reported by several studies in the USA (Marino, et al., 1989; Rae, et al., 1991; Tepper, 1992).

Exposure of construction workers and their families to air borne asbestos fibers from asbestos cement causes asbestosis leading to illness, disability and premature death (Richter, 1984).
Occupational solvent exposure of construction workers, such as painters, increase the risk of their being prematurely pensioned due to neuropsychiatric disorders (Lindstrom, et al., 1984). Even the safer water-based paints may result in irritation of the skin and mucous membranes and lead to headache when safety precautions are not used (Hansen, et al., 1987).

Exposure to 2-nitropropane, when applying coating material, can cause fulminant and fatal hepatic failure (Harrison, et al., 1987).

Inhaling roofing asphalt fumes containing hydrogen sulfide has led to a rare but devastating injury involving permanent severe neurological sequelae (Hoidal, et al., 1986).

Many women are involved in construction work and the work conditions may increase their vulnerability to spontaneous miscarriage. High mortality rates from accident and infection have been noted in children living on construction sites (Bhatt, et al., 1988).

The movement of major items of equipment such as turbines, bulldozers and the lorries required to move large amounts of soil and concrete provides major hazards for road users (Webster, 1960).

Special health services are often provided by construction companies for large projects. Such facilities may or may not be made available to other vulnerable communities, such as resettlers and camp-followers. The facilities may or may not be integrated into the national health system when the construction phase is completed.

3. Nutrition

The nutritional status of poor labourers together with anemia, associated with parasitic burden, significantly reduces productivity (Brooks, et al., 1979; Wolgemuth, et al., 1982). The energy expenditure of heavy labour may exceed energy intake.
F. References


Appendix 5


APPENDIX 6 AGRICULTURE

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A. Health Problems Associated with Changes in Land Use

Many development projects, including mining, farming, forestry, construction, reservoirs and road building activities reduce the land available for gathering of food, water or fuel and cause increases in respirable dust levels.

Land tenure, legal access and control over land can have important effects on household income and hence health. Other determinants of household income include improved access to credit, working capital and physical security.

Common property resources and forests play a critical role in cushioning the effect of seasonality and food shortage. This role is especially important for the more vulnerable members of communities and households whose entitlements are few. Policies which protect common land strengthen the coping mechanisms of the poor (Agarwal, 1990). The very poor, and among them pregnant and lactating women and preschool children are especially vulnerable to infectious diseases as a result of bodyweight changes associated with seasonal malnutrition and immunodepression (Carswell, et al., 1981).

Vulnerable subsistence economies depend on unoccupied lands for many of their daily requirements. It is often the duty of women to gather wild food, fuel wood or to collect water. When such land is used for a development project, the community may be deprived of a vital resource. Alternative supplies of that resource may be further away and the workload of women is increased. Switching land use from subsistence to cash crops can also increase women’s workloads. The cash crop may require intense weeding but the cash earned may be controlled by men and not used to buy additional food for the family.

The consequence, for women, is a reduction in the time available to care for children or attend at health clinics.

Development schemes have sometimes ignored or suppressed women’s land rights, negotiations about land reallocation being conducted with men. Loss of land customarily used for subsistence crops has been associated with food scarcity (Rogers, 1980). One important determinant of family nutrition is control of cash within the household. Three basic farming household types have been recognised:
Review of Health Hazards: Agriculture

Appendix 6

- Women do not participate (some Moslem communities);
- Women participate with men;
- Women work separate fields and crops.

Land distribution schemes may promote colonization of new lands. Settlers are likely to encounter natural foci of communicable diseases for which they may be ill-prepared. An example would be encounters with leishmaniasis in the steppes of the former USSR. In forest areas opening of new roads has encouraged an influx of farmers, miners, loggers and others. There have been serious resurgences of malaria concentrated on settlements, mines and periurban areas. New lands are likely to be marginal: in wetter areas they may be forested and in drier areas they may be semi-arid. The pattern of diseases encountered will vary.

A wide range of development projects increase the value of farming land, promoting land sales and cash cropping and reducing food security. See also Forestry (Section 1 of this Appendix).

Watershed degradation increases surface run-off. Erratic stream flows lead to alternate water shortage and flooding. Floods contaminate potable water supplies. Water shortages lead to reliance on contaminated supplies. Both promote waterborne disease transmission.

Exposed, dry soils turn into dust bowls. High levels of air-borne dust promote eye and respiratory disease and increased transmission of meningitis (Greenwood, et al., 1984).

B. Agricultural Components

Lipton and de Kadt, Agriculture-Health Linkages WHO 1988, extensively review agriculture-health linkages, identifying four components of agriculture in which health linkages can occur:

- Inputs, such as land, water (see irrigation), agrochemicals, draught power and labour;
- Technologies (hydraulic, mechanical, biological and post-harvest);
- Structures of work and ownership (including assets, laws and customs);
- Outputs (such as choice of crop).
Where the population is largely rural, agricultural projects are major determinants of food intake, food requirements for work and some infectious diseases. Children's health is particularly affected by the interaction of malnutrition and infection. What children eat is partly determined by agricultural development. There is also feedback of health into agriculture. Healthier farmers and workers are more productive and more careful, more able to risk experiments with new crops, and less likely to migrate to towns.

C. Agricultural Labour

Landless agricultural labourers are a vulnerable group because of low and unstable wages and low levels of employment (Lipton & de Kadt, 1988). They may, for example, be unable to purchase sufficient food during the slack season. The high energy requirements of manual labour may exceed the energy levels of food intake. Farm workers are exposed to new hazards of agrochemical poisoning and machinery besides traditional health hazards of bites and stings, dehydration and back injury. The shift in Asia from increasing draught power to tractors usually displaces labour without increasing output. This shift is often encouraged by subsidies on fuel, tractors, or credit.

Example

Traditional agricultural hazards accounted for 5% of time spent on field work by casual rural labourers in India (Lipton, et al., 1988).

During periods of food shortage young farm workers in India and Bangladesh succumb to lathyrism by consuming the grass pea (Dwivedi & Prasad, 1964; Haimanot, et al., 1990; Palmer, et al., 1989).

Women gain mixed benefits from agricultural labour. The extra income may provide extra food but the type of work may be incompatible with child care. As men move out of the fields and into the cash economy, women's role in subsistence production has increased.
D. Choice of Crop

Crop development programs may neglect staple root crops and coarse grains in favour of high protein or fine grain export crops. They may reduce the income or security of vulnerable groups, reduce the production of foods for home consumption or increase the price of purchased foods.

Crops with a high value, high yield and high protein content may represent a health hazard to poor farmers (Lipton, et al., 1988). Lipton suggests that the poor need high energy crops rather than high protein crops. They need reliable yields rather than high yields and stable market demand rather than extreme price fluctuations. They need varieties that are resistant to drought and disease, which are easy to store and require limited labour. High yielding varieties may be deficient in micronutrients such as iron, vitamin A, iodine or niacin.

Promotion of export crops (often associated with structural adjustment programmes) may adversely affect production of food crops through competition for productive resources, but the available evidence is mixed (Cooper Weil, et al., 1990). The effect of cash crop production on income and nutrition is mixed (Longhurst, 1988). Change from subsistence to cash cropping is usually accompanied by a reduction in crop diversity. The simplification of traditional diets can lead to nutritional unbalance and increasing malnutrition (Fleuret & Fleuret, 1980).
On the other hand, there are crops such as tea, where the nature of the land and the market ensures a more stable employment from an export than from a staple crop. In Africa, it has been suggested that change to modern varieties of crops may be less harmful than no change at all (Lipton, et al., 1988).

The poor usually obtain their sustenance more from vegetable than animal foods. Animal development projects may divert land from producing staple crops and reduce the food supply of the poor.

The replacement of subsistence crops by cash crops often has a direct effect on women. Where a woman’s workload is increased there may be reduced time to care for her family or attend at health clinics. Mechanization alters the division of labour. Tractors and irrigation bring larger areas under cultivation, giving women increased land to weed. Intensive sugar cane production requires more weeding on the same unit of land.

1. Communicable Disease

The development of natural resources has an effect both on the environment and on human contact with the environment. Consequently, there may be major changes in the abundance of vector breeding sites and in the degree of contact between people and vectors. The abundance of animal host reservoirs may also change.

The use of pesticides in agriculture may hasten the development of pesticide resistance in disease vectors. This problem could be reduced if some categories of insecticide were reserved for public health use, as has happened in Sri Lanka. However, such schemes are difficult to regulate and do not overcome problems of cross-resistance.

Latrines are rarely incorporated in farm plans. Open defecation leads to disease transmission. Cheap, shallow pit latrines are often all that is required.

Rice cultivation is frequently associated with an increase in malaria. There is a succession of different mosquito species in rice fields as sun-loving species are replaced by shade-loving species when the rice grows. New high yielding varieties (HYV) produce less shade and may alter this succession. On the other hand the large amounts of fertilizer and pesticide used with HYV’s may deter certain malaria vectors. They may
also adversely affect existing aquatic food chains and soil microorganisms.

Example

The malaria vector *An. culicifacies* used to be very common in Indian rice fields but is now much reduced in some areas, possibly due to the introduction of new rice varieties (Reuben, 1989).

In one project, there was initially a plan to cultivate rice. This was changed to cotton cultivation when it was recognised that uncontrollable malaria transmission could result.

Commercial agriculture often employs seasonal migrant labour who may be more susceptible to communicable diseases such as malaria (Kanjanapan, 1983). See also *Labour Mobility and Plantation Agriculture*.

Example

A study in Thailand contrasted malaria in sugarcane plantation owners with malaria in migrant labourers from a non-malarious region. The migrants knew less about transmission; had less access to mosquito nets; were less likely to take anti-malarial drugs; and had a higher malaria prevalence (Kanjanapan, 1983).

Women may grow or make products for sale but have no access to markets. They may be required to trade sexual favours to obtain market access (such as transport from truck drivers), credit, raw materials, or wage labour. This enhances the transmission of STDs into uninfected populations.

2. **Food Security**

Food security is physical and economic access to food for all people at all times. Lack of food security is associated with poor nutritional status, particularly in young children (Dearden & Cassidy, 1990; Payne, 1990). The malnourished child is more susceptible to
communicable disease. Food insecurity is a concrete manifestation of poverty that may be more meaningful than income levels.

The combination of low intensity of infection with many different species of parasites in conjunction with inadequate diet probably has a major nutritional affect on children.

Changes in household food security and nutritional status can occur, for example, when projects affect: food production, food availability, purchasing power, feeding practices, prevalence of infections, and workload.

Example A positive change in nutritional status was observed on a paddy rice development scheme in Sri Lanka. It was noted that rice was a traditional crop which had cultural and nutritional importance in the community. The scheme provided a surplus of the traditional crop which could be stored, against seasonal fluctuations, or sold (Holmboe-Ottesen, et al., 1989).

Transitory and chronic forms of food insecurity are recognised. Transitory food insecurity can be associated with seasonal shortages or, for example, a shift from subsistence to cash crops. Changes from subsistence to cash crops may reduce the availability of subsistence food crops within the home. Income may be insufficient to buy food in local markets. The price of market food may rise. Cash may be controlled by male members of the household who do not use it for the benefit of the elderly, women and children.

3. Non-Communicable Disease

See also Agricultural Processing Industries (Section K of this Appendix.

a. Pesticides

The Bank's Handbook on the Use of Pesticides in the Asia-Pacific Region (1987) provides detailed information on the health hazards of pesticides and includes safeguard and mitigation procedures. The following are additional points.
(i) **Chronic versus acute poisoning.** Acute pesticide poisoning has received more attention than chronic effects. Recently circumstantial evidence has been published of increased adult male mortality in intensive rice production systems in North Luzon, Philippines. Detailed studies at IRRI are underway which tend to confirm the evidence of chronic poisoning. IRRI reiterate the need for integrated pest management and have developed more pest resistant strains of rice. It is possible and practical to monitor pesticide exposure by routine medical examination.

(ii) **Market availability of older pesticides.** Many older and more toxic pesticides are still available in stores and market places. Their cheap price makes them attractive to smaller farmers who may thereby circumvent Bank policy. This may be of particular concern in smallholder agriculture development.

(iii) **Pesticide Applicators.** Pesticide is often applied by itinerant, unskilled, unsupervised operators. It is still common to observe storing, mixing, application and disposal without adequate safety precautions. Operators should wear cotton overalls, washed daily, as well as gloves and disposable face masks.

(iv) **Mosquito resistance.** Field breeding mosquitoes are one of the non-target organisms affected by pesticide use. Cross-resistant strains are selected which are difficult for the public health sector to control. The prevalence of malaria may then increase. Some specialists have suggested that public health requirements should be considered when choosing agricultural sprays.

(v) **Wild foods.** Many species of wild food, including fish, molluscs, crustacea, insects and vegetables, are harvested among cultivated crops. Such foods are especially important for the landless poor and for children. Pesticides may either remove or contaminate such foods.

Unintentional acute or chronic pesticide poisoning is an occupational hazard of farm workers. It is a growing and serious problem, but poorly documented (Loevinsohn, 1987; McCracken & Conway, 1987; Pingali & Marquez, 1990). Some 50 million people have regular contact with pesticides and 500 million have less regular contact. The latter category may be particularly at risk because they will usually be less well informed of the hazards. A disturbing trend is the use of extremely hazardous compounds such as parathion methyl and monocrotophos. Cases of pesticide poisoning are often misdiagnosed.
Example

Pesticides are not necessarily dangerous to human health. DDT, for example, is about as hazardous an acute poison as aspirin (Conway & Pretty, 1991). However, its chronic effects in the environment would lead no one to wish to consume DDT unknowingly or continuously.

There may be over one million cases of unintentional pesticide poisoning per year (WHO, 1986). Low levels of literacy and education in rural communities with poor access to training increase the risk of pesticide poisoning. Protective clothing of the type used in Northern countries is too expensive and unsuitable for hot countries. Lack of proper supervision is also important. The Pesticide Management Section of the Natural Resources Institute advocates the use of lightweight cotton overalls that are frequently washed. Poor access to water and soap for decontamination is a further risk factor. Operatives frequently eat and smoke during spraying operations. Aerial spraying of insecticides often contaminates operatives, casual bystanders and local fauna, resulting in serious levels of exposure especially to organophosphorus type compounds.

A recent study from the Philippines suggested that the cost of ill-health from pesticide exposure may be greater than the value of the extra crop produced (Pingali, et al., 1990).
Example

A study in Malaysia suggested that 92% of agricultural workers used pesticides. Of these some 7% had been poisoned in one year. Hospital admissions for pesticide poisoning were composed of 14-32% occupational poisonings and an equal number of non-occupational accidental poisoning. In a study in Sri Lanka some 70% of accidental poisonings were due to occupational exposure. In Latin America some 10-30% of agricultural workers showed evidence of pesticide poisoning in certain selected groups. Studies of intense rice cultivation in the Philippines attributed both mortality and morbidity to chronic pesticide exposure (WHO/United Nations Environment Programme Working Group on Public Health Impacts of Pesticides Used in Agriculture, 1990).

Accidental mass poisoning with agricultural chemicals is more dramatic but rarer. It occurs when people consume treated grains or contaminated stored produce. In Iraq some 6350 people were admitted to hospital and more than 459 died, after eating bread prepared from cereals treated with methyl mercury fungicide (Bull, 1982). Parathion has been responsible for mass poisoning in India, Egypt, Colombia and Mexico. Hexachlorohexane treated grain caused 3000 cases of poisoning in Turkey.

Accidental poisoning due to the use of pesticide/chemical containers as cooking utensils, for water storage and collection is a major hazard. Such empty containers are often sold in the markets to poor people. Poor labelling may cause people to ingest insecticide by mistake.

Pesticide residues in locally grown vegetables are frequently far in excess of the acceptable limits. Green leafy vegetables are especially at risk (Conway, et al., 1991). Excessive residues are also found in fish from ponds and rivers near sprayed fields. Residues and propellants can deoxygenate waters causing large scale fauna depletion and food loss.

Exported foods, including fruits and meats, are rejected at the port of entry in the UK, if they contain higher residues of pesticide than locally grown produce.
b. **Crop specific occupational hazards**

There are special occupational hazards associated with particular crops (Ghosh, et al., 1979; Nag Anjali, 1986). The agricultural tasks associated with these crops may tend to be gender specific. For example, women may be employed for tea and tobacco picking. Teapickers are exposed to accidents and falls associated with steep slopes, insect and snake bites, and the high levels of pesticides used in tea growing.

Example Green syndrome is an occupational health hazard associated with picking and curing tobacco leaves (Ghosh, et al., 1979). Rice planter’s keratitis is an occupational eye disease (Lim Heng Huat, 1983).

c. **Nitrites**

The global use of nitrogen fertilizers has increased exponentially since the second world war. Much of the recent increase has been in developing countries and in support of HYV cereals. Most fertilizer is lost to surface and ground-water, finding its way into drinking supplies. There is a documented risk that nitrates may be converted to nitrites in the human gut through the action of bacteria (Conway & Pretty, 1988). Nitrites bind to haemoglobin, impairing the transport of oxygen. The potential risk is greatest in bottle-fed infants and gives rise to the blue-baby syndrome. At present the condition is rare but there is concern for its future increase.

Nitrogen and phosphate contamination of the drinking water reservoirs can stimulate production of harmful toxins by blue green algae (Turner, et al., 1990). Toxic algal blooms associated with agricultural run-off can cause dermatitis and gastrointestinal disease. Livestock may be killed.
d. **Plant toxin**

Certain varieties of crops, such as cassava, contain toxins. Promotion of these varieties may be associated with a real risk of poisoning among consumers. Production and consumption of grass-pea is increasing in India, Ethiopia and Bangladesh. Over-consumption of improperly cooked grass-pea leads to lathyrism, a neurotoxic disorder, more common in young men (Haimanot, et al., 1990). Grass-pea is especially tolerant to drought, poor soils and pest attack. It can be intercropped and is useful for nitrogen fixation. These characteristics make it attractive to poor peasants, especially during times of stress. In an Ethiopian study, consumers were aware of its toxic potential but found it preferable to starvation (Haimanot, et al., 1990).

Many health hazards arise from contact with agricultural produce, domestic animals, animal excreta, animal products and human excreta used as fertiliser. *See also Livestock and Agricultural Processing Industries.*

E. **Plantation Agriculture**

*See also Forestry and Labour Mobility.*

Plantations are frequently developed to support export crop production. They have many similarities that are independent of region or government (Laing, 1986). They employ labour living in enclaves that may be physically or culturally isolated from other communities. There is considerable information concerning the harsh social conditions experienced by the plantation workforce and the increasing labour militancy that this can provoke. Contributors to poor health include: seasonal unemployment, mechanisation, poor housing, inadequate diets and lack of access to health care and education.
Example When the tea estates in Sri Lanka were nationalised during the mid-70's, the poor health and welfare conditions of the labourers received public attention. Chronic malnutrition and infant mortality rates were twice the rural average. Child labour was common; education facilities were minimal. Water supplies were inadequate. State ownership, uniform health policies and donor assistance have since led to a substantial improvement (Laing, 1986).

Health care facilities may be restricted to skilled workers; women, children and contract workers may be excluded. Health care facilities may not be planned for ease of access by workers who lose wages if they attend during working hours. This can affect the uptake of immunization and antenatal services. Child mortality and morbidity rates are frequently higher on plantations. Health services tend to be entirely curative with little attempt at sanitation, environmental protection or vector control.

On the other hand, plantation managers can deliver health care to an easily identified workforce. Plantation vehicles may be used as transport to remote health centres which would otherwise be inaccessible.

Example There was widespread malnutrition on Malaysian rubber estates during the 1970's. Worm infestation, leptospirosis antibodies and snake bite were common. However, water supply and sanitation were good. Houses were well-built but overcrowded (Lim Heng Huat, 1983).

Plantations may dispossess subsistence farmers of their land and make them landless labourers. Non-permanent labour often has the poorest housing, lacking environmental health provision. On average, 80% of the agricultural worker's wage is spent on food. High-priced commercial foods may be consumed as a result of poor access to peasant markets. Food security is poor where labourers have no rights to gardens of their own.
Communicable diseases on plantations may be exacerbated by poor conditions or by the importation of cheap labour from endemic regions (Packard, 1986).

New plantations are established in support of resettlement schemes in programmes of smallholder agricultural development. The smallholders are often switched from subsistence to cash crops. Success may depend on the availability of food gardens. Nutritional problems are common.

**Example**

Ten thousand smallholders were settled on an oil palm scheme in Papua New Guinea. Each smallholder established food gardens under the growing oil palms. These produced a substantial surplus which was traded in the local markets for other foods such as fish. There was considerable entrepreneurial activity. When the oil palm canopy closed the food intercropping would no longer be possible. It was recommended that blocks be permanently set aside for food gardens so that food production could continue (Benjamin, 1985; Benjamin & Wapi, 1982).

By contrast, in a different Papua New Guinean study an increase in underweight children was noted two years after the commencement of a rubber resettlement project. The effect was attributed to transitional malnutrition as it takes several years to earn returns from a rubber plantation (Fillmore & Hussain, 1984; Shack, et al., 1990).

Tree crop plantations often provide habitats for shade-loving vectors and the animal reservoirs of certain parasitic infections (Mak, et al., 1982). The associated diseases may be an occupational hazard of plantation workers or may be more widely distributed among their dependents. For example, rubber plantation workers contract malaria as an occupational hazard because they cut the trees during the hours of darkness.
Example

Sub-periodic brugian filariasis is transmitted by *Mansonia* mosquitoes in Malaysian rubber estates. The estates are surrounded by swamp forest inhabited by monkeys which are heavily infected with the parasite. The monkeys are frequently found in the estates near to human habitation. The infection is present in estate workers and their dependents (Mak, et al., 1982).

F. Mechanisation and Agriculture

Reduction of livestock associated with a switch to mechanized agriculture has been associated with malaria outbreaks when the vector switches to feeding on a human host (Ault, 1989). Mechanization may increase the number of rice crops that can be grown during the year and extend the malaria transmission season (Service, 1989).

Cost of tractor hire/use is so great in smaller fields that it drastically reduces family income from land especially in regions of high unemployment and food scarcity.

Tractors are well known as an important cause of agricultural accidents. They are unstable because of their need for high ground clearance. Adults and children living in rural areas of developing countries often have very little appreciation of the dangers associated with these vehicles.

Example

In the UK most farm accidents are associated with machinery (Conway, et al., 1991).

Introduction of a mechanical rice husker in Bangladesh, controlled by men, removed one of the few income generating options open to poor rural women (Greeley, 1987). Reducing labour intensive occupations and displacing labourers can lead to reduced food security for vulnerable groups.
Two reviews of the health impact of water resource development in South East Asia have been prepared by the Faculty of Tropical Medicine, Madhol University, Bangkok (Harinasuta, et al., 1978; Sornmani & Harinasuta, 1988).

1. Communicable Disease

The problems of vector-borne disease associated with irrigation and dams have received considerable attention. Unfortunately, this has still not yet been accompanied by significant policy changes or appropriate planning procedures.

Irrigation projects cause profound ecological change that often encourages mosquito breeding. Many of the world’s most efficient malaria vectors breed in or around rice fields. Malaria almost invariably increases as a result of surface irrigation. There is considerable regional variation. See Cross-Cutting Health Issues (Appendix 5).

Example

In Afghanistan, the Kunduz valley was developed during the 1960's for the cultivation of rice, cotton and vegetables. The rice fields and irrigation canal overflows created ideal mosquito breeding sites and vivax malaria incidence increased from 5% to 20%. Malaria incidence is now highest in irrigated rice field areas, where most of the population live (Dukhanina, et al., 1975).

Irrigation usually lengthens the malaria transmission season.

Much malaria associated with irrigation is due to untidy practices and various simple measures could be taken to prevent outbreaks. Efficient water use is often the key to reduced vector breeding. The key to efficient water use and the maintenance of water channels lies with the division of responsibility and financing between the individual, the community, the irrigation system management and the government (Ault, 1989; Small, 1987).
Schistosomiasis, or Bilharzia, has been a major problem in African irrigation and reservoir developments. In Asia, however, the distribution is restricted. The disease is caused by a parasite which is excreted in human feces and then enters an amphibious snail host. After shedding by the snail, it penetrates the skin of people who touch infected water. There is no schistosomiasis between Iraq and Thailand, except for a very small focus in Kerala, India. However, migrant labour has been responsible for the importation of schistosomiasis into new areas (Meskal & Kloos, 1989). See also Labour Mobility (Appendix 5).

It has been suggested that schistosomiasis may become established in India with the current construction of the Narmada Valley Development Project, although the parasite is currently rare in India.

Foci of schistosomiasis (species *S. mekongi*) have been identified in the Mekong river basin which are of great potential importance. Small foci of a species with limited health importance are reported from southern Thailand and Peninsular Malaysia. At present it seems unlikely that the snail hosts will flourish in large or small reservoirs (including night storage dams), but they may be found in tributary streams.

The most serious form of schistosomiasis in the region (species *S. japonicum*) is found in a belt across PRC, in Central and South Philippines and in Central Sulawesi. It is associated with low-lying flood plains and swamp forest (Palawan swamp in the Philippines). There are many animal hosts, including carabao, so that control of human waste is much less important than in Africa. Human exposure to infected waters is associated with:

(i) **Recreation.** Such as swimming;
(ii) **Occupation.** Such as farming, collecting wild foods, fishing and tending domestic animals;
(iii) **Domestic activity.** Such as fetching water, washing and bathing.

Transmission occurs in traditionally cultivated ricefields but intensive production removes the snail vector. Swampy irrigation and drainage ditches, creeks and streams should be provided with crossing points. A curative drug is readily available and supplies should be ensured to health centres near new developments. Appropriate monitoring and diagnostic laboratory services are also required. Staff shortage at health
centres may be a problem. Continuing health education may sometimes be provided through agricultural extension services. Chemical control of snails is less important than good project location and design. Snail screens are unlikely to be effective.

In many dry areas in Africa (Nigeria, Kenya, Cameroon) the development of small dams and reservoirs has increased the prevalence and intensity of infection with both dracunculiasis and schistosomiasis (Adekolu-John, 1983). See also Energy (Appendix 7).

Several acute mosquito-borne arbovirus infections are important in irrigation schemes. They are often associated with a bird or animal reservoir of infection. Japanese Encephalitis (JE) is an example.

Example

The Mahaweli rice development project in Sri Lanka provided breeding sites for the mosquito vector of JE. A separate development project encouraged pig production near the rice fields. Pigs are the reservoir hosts of the JE virus. Epidemics seriously disrupted the newly settled communities (International Rice Research Institute and WHO/FAO/UNEP Panel of Experts on Environmental Management for Vector Control, 1987).

Other potential problems are listed in WHO’s Guidelines for Forecasting the Vector-Borne Disease Implications of Water Resources Development (Birley, 1991).

Despite the intentions of planners, communities will use irrigation water for domestic purposes, especially during the dry season. They may also defecate on the banks of canals and use the water for anal cleansing.

2. Other Health Hazards and Irrigation

See also Resettlement (Appendix 5).

Irrigation return water contains more salts than the original supply, due to leaching from the root zone. High levels of salts in drinking water make it unpalatable, creating downstream drinking water shortages.
Increased salt levels in drinking water associated with fertilizers has been regarded as a major cause of high blood pressure in regions where bore hole water is commonly used (Meakins, pers. comm.). It has been suggested that consumption of plants grown in such water may sometimes induce crippling bone diseases (Environmental Resources Ltd, 1983).

Waste water containing pathogens and heavy metals is increasingly being used for irrigation. The development of appropriate safety measures is of continuing concern (Shuval, 1990). Correlations between wastewater use and children’s diarrhea have been observed.

Example

About 50% of the water-borne sewage produced in India is used for irrigation (Shuval, et al., 1986).

Withdrawing freshwater water for irrigation may affect the quantity available to dilute and carry wastewater.

H. Fisheries

This section includes fresh and salt water, capture and culture fisheries (aquaculture). An important conference on environment, including public health, and third world aquaculture was held in Bellagio in 1990, entitled Aquaculture and Environment in Developing Countries (Pullin, et al., 1991). The health hazards of fisheries developments can be summarised as follows.

(i) Communicable disease. Fish, fish products and fishponds can easily become contaminated with pathogens which may affect workers, processors and consumers. (See 2, 4, 5, 6 and 7 below).

(ii) Non-communicable disease. Water can easily be contaminated with trace metals, pesticides, disinfectants, antibiotics, hormones and biotoxins. (See 1, 2, 3, and 4 below)

(iii) Injury. Fishing and aquaculture can be hazardous occupations with exposure to extreme environments and danger of drowning. (See 7 below)

(iv) Nutrition. Fishing folk are often impoverished and dependent on a variable resource. Aquaculture development can
cause economic shifts or changes in access to resources that will disturb basic household nutrition. (See 6 below).

1. **Biotoxins**

Blooms of toxic algae occur in both fresh and sea waters, worldwide (Dunlop, 1991). They are sometimes referred to as "red tides". One cause is excess nutrient associated with agricultural runoff. The algae kill fish and render molluscs and crustaceans toxic. The toxins can cause paralytic shellfish poisoning. Children are especially vulnerable because toxic thresholds are very low.

In aquaculture developments, monitoring of harmful algal species is crucial for public health purposes but must not replace testing of produce for phycotoxins. Site location can be crucial.

Ciguatera is a severe neurotoxin sometimes harboured by certain Pacific and Caribbean reef fish. It originates in plankton and is concentrated in the food chain. Fear of poisoning severely restricts fish exports from several island nations. Outbreaks also disrupt the tourist industry. Ciguatoxic biotopes can be created by development activities that disrupt the reef system. These include the construction of hotels, aircraft runways and wharves (Lewis, 1986).

Processing of sea-food, particularly crabs, has been associated with increased prevalence of chronic obstructive airways disease among the workforce (Orford & Wilson, 1985).

2. **Water Pollution**

The pollution by human excreta of waters used for harvesting shellfish can be the source of many enteric infections. Molluscs, particularly bivalves, are grown almost exclusively in waters with uncontrollable qualities. The bivalves accumulate pathogens and chemical contaminants.
Example  
An epidemic of shell-fish borne hepatitis A in China in 1988 affected 292,000 persons and was related to the consumption of contaminated clams (WHO, 1991).

3. Use of chemicals in aquaculture

The potential human health hazard associated with the use of antibiotics in intensive fish production is a matter of current debate. See also Livestock (Section J of this Appendix). Many countries now refuse to import shellfish which have been treated with antibiotic.

Example  
Export of Philippine shrimp to Japan is severely affected by Japanese inspection for antibiotic contamination, according to The Philippine Star, April 28, 1992.

Fish poisons such as phosgene producing chemicals are frequently used to harvest fish and are potentially lethal to people if wrongly handled.

4. Wastewater reuse in aquaculture

Human and animal excreta can provide a valuable source of fertilizer for fish ponds. The technique has been practised successfully in Germany for many years. Treatment and monitoring is required to minimise health risks. Pathogen removal must occur in pretreatment processes and during use. Thereafter, aquaculture produce must be treated for pathogen removal. Pretreatment of raw sewage by 8-10 day detention in anaerobic ponds is required to remove settleable pathogens. Nightsoil should be stored for two weeks before use. A stable plankton community should be established before fish stocking. Loading of wastewater into fishponds must be suspended for two weeks prior to harvest. Harvested fish must be held in clean water to evacuate their guts. Threshold concentrations of bacteria in fish muscle must not be
exceeded. *Salmonella* concentration should be zero. Industrial effluent must be carefully monitored for toxic chemicals and metals. Culture of molluscs in wastewater systems is not advisable because of bioaccumulation of contaminants (Pullin, et al., 1991).

In some regions there is a risk of parasite transmission from eating raw or improperly cooked fish and molluscs. In NE Thailand, raw fish eating is widespread and there is a correspondingly high prevalence rate for the associated parasitic diseases.

5. **Fish processing**

Quality control is essential to ensure the safety of aquatic produce. Rejection of shipments from DMCs can have catastrophic effects on producers. Contamination can occur at many stages. For example, peeling of shrimps is the process which affords greatest risk of *Salmonella* contamination (Pullin, et al., 1991).

6. **Vector-borne Disease and Fish Ponds**

Fish ponds are often built informally, to low standards and to meet local needs, and are not recorded in any inventory (Jewsbury & Imevbore, 1988). In some regions, they provide breeding sites for vectors such as malaria mosquitoes. For example, brackish coastal fish ponds and lagoons in Indonesia are important breeding sites of malaria mosquitoes when they are covered with an algal mat or abandoned. In India and Pakistan fish ponds could breed malaria mosquitoes although the water may often be too contaminated. In Africa, inland fish ponds support snail vectors of schistosomiasis as well as mosquito vectors. Schistosomiasis is not associated with fishponds in the Asian region.

The health hazard represented by large numbers of small reservoirs is likely to be very great because of the total area and shoreline that they represent.

Fish ponds become mosquito breeding sites when they are poorly managed. Good management involves removal of surface and emergent aquatic vegetation which provides shelter for mosquito larvae.
7. **Occupational Health**

A new health risk to tilapia hatchery workers in the Philippines has emerged with a change in breeding technique. Workers now spend longer wading the ponds and suffer from an increase in foot infections (Pullin, et al., 1991).

I. **Forestry**

*See also Changes in Land Use, Plantation Agriculture, Resettlement and Cross-cutting Issues (this Appendix and Appendix 5).*

1. **Communicable Disease**

In areas of tropical forest, malaria is transmitted by mosquitoes breeding in two separate habitats. Where mosquitoes breed in deeply shaded pools or streams, malaria transmission is associated with sojourn in the forest and affects small groups of people, such as forestry workers. Other mosquitoes breed in partially shaded or sunlit water. Such breeding sites occur at the forest fringe or as a result of forest disturbance and deforestation. Large groups of people may be affected and epidemics occur. Resettlement schemes should consider siting new settlements as far as possible from the forest. In Indochina, a severe drug resistant malaria has evolved and this is now spreading throughout the region. See *Forest Malaria in Southeast Asia* (Sharma & Kondrashin, 1991).

**Example**

In Thailand the malaria vector in the forest is *An. dirus* and that in the transition zones is *An. minimus*. Malaria incidence is associated with the proximity of houses to the forest. Malaria is more common in poorer people who seek money from higher risk activities associated with the forest. When one member of the family has malaria others are more likely to become infected (Butraporn, et al., 1986).

Deforestation removes the shade loving mosquitoes but assists the sun loving species. Later, natural regrowth or tree crop plantations may recreate the shaded habitat. Cyclical malaria epidemics in Malaysia over a period of some fifty years were correlated with rubber replanting in
response to market fluctuations (Service, 1989; Singh & Tham, 1990).
The vector breeds in sunlit streams. Deforestation for tea estates in Sri Lanka created breeding sites for the malaria vector and conditions for malaria epidemics. More recently, clearing scrub vegetation for the Mahaweli Development Programme has had a similar effect. By contrast, the growth of rubber trees and fruit orchards in Thailand creates shaded streams in which the malaria vector prefers to breed.

Trypanosomiasis occurs in Africa in association with forests but it does not occur in Asia.

2. Other Health Hazards of Forestry

The occupational safety record of logging and woodworking industries is often poor (Hong, 1987). Hill logging operations involve many dangerous procedures. Most of the labour force are local contract workers with little education or experience of the hazards. The labour force may live in poor accommodation in logging camps with inadequate food and sanitation. They may be overworked so that accumulated fatigue contributes to low efficiency and high accident rates. Logging trucks are often overloaded and logging roads poorly constructed. Woodworking machinery is fast moving and dangerous, especially where guards are inadequate.

Example

In Sarawak 73% of industrial accidents were recorded from the logging and woodworking industries during 1979. Of some 20,000 workers, 5% were injured and 0.25% were killed. The industry death rate was twenty times higher than Canada’s (Hong, 1987).

3. Food Security and Forestry

*See also Food Security and Agriculture (page 7 of this Appendix).*

Forestry projects typically change community access to forest produce: food, fuel, fodder and other products. Commercial forestry decreases access, can lead to deforestation, or establishes monocultures.
Replacement of grazing areas and multispecies forests with monoculture plantations may cause a decrease in available fodder or forest foods for human consumption.

The forest industry frequently does not implement replacement planting programmes and this has long term implications for food security (Mann, 1990).

Example  Eucalyptus has been planted in Indian forests in place of traditional mixed deciduous stands. There are conflicting views of its value as a source of fuel and fodder. Women’s workload in collecting fuelwood may have increased. In one study, the number of cattle owned per family dropped from seven to one or two because the forest browse was lost (Price, pers. comm.).

For children in particular, foraging in the forest may provide vital supplements of minerals and vitamins to their staple diet. Fodder is collected to feed milch cattle or other animals and the milk provides extra food supplements. Forests can also produce substantial quantities of fodder for domestic animals. However, such forest browse is not always suitable for cattle.

Where labourers or farmers maintain home gardens for food production, the impact of tree crop projects on community food security is reduced. Community forest projects can increase and safeguard forest access.

Example  In forested areas of Northern Thailand 60% of all food, 40 different products, including nuts, roots and berries, may come from the forests (Hoskins, 1990).

Trees are an integral part of food security strategies for rural people (Hoskins, 1990). Tree ownership provides savings and security; an asset which can offset sudden contingencies such as the cost of ill health (Chambers & Leach, 1990). Trees are almost invariably incorporated in
production systems where farmers have lived for extended periods. Their value is enhanced in savannah parklands, where most tree cover has been removed. Recent initiatives from FAO have sought to create linkages between foresters and nutritionists, see Building nutritional considerations into forestry development efforts (Ogden, 1990).

Fuelwood is essential for releasing the nutrients in food through cooking, processing and preserving surplus food supplies. Where fuelwood is scarce, food and time are also likely to be scarce. Fuelwood collection makes substantial demands on women’s time. Less time may then be spent cooking and food may be more easily contaminated, increasing disease incidence. Less time may be available for child care. Where fuel is scarce families may eat one instead of two cooked meals per day, or use non-boiled water, or use foods that cook quickly but contain less nutrient (Fleuret, 1990). See also Energy (Appendix 7).

**Example**

Women in rural areas of south India purchase fuelwood to save time for other tasks even though this reduces their disposable income (Cooper Weil, et al., 1990).

A study in India suggested that the energy cost of collecting fuelwood, water and other domestic chores represented nearly one third of a woman’s daily expenditure (Cooper Weil, et al., 1990).

### J. Livestock

#### 1. Malaria and Pastoral Nomadism

In India and Nepal, particularly, there are huge populations of livestock which depend on forest forage as there is not enough grazing land (Kondrashin, et al., 1991). Herders reside for considerable periods of the year in the forest where they contract malaria. As they circulate to their villages on the plains they disseminate the parasite.
2. Drug Residues and Livestock

In some countries large proportions of livestock receive drugs for therapy, prophylaxis or growth promotion. For example, chickens grow 10% faster when fed on antibiotics. The possibility exists that residues will occur in human food products. The parent drug is metabolised by the animal into many derivatives (Cravedi, 1991). The maximum acceptable daily intake of either parent drug or derivatives has not always been established. Some of the drugs have known teratogenic potential.

Sub-therapeutic doses of antibiotic in the animal body and residues in the environment facilitate the development of resistant strains of bacteria, including Salmonella (Yndestad, 1991).

Example

In Norway about twice as many antibiotics are consumed by animals and fish as by humans (Yndestad, 1991).

In India about 80% of the animal production industry uses antibiotics and other drugs (Singh & Vijjan, 1987).

In the USA, an outbreak of salmonellosis resistant to many antibiotics was traced to hamburgers derived from antibiotic treated cattle (Conway, et al., 1991).

The presence of residues of pesticides, herbicides, fumigants (Cordle, 1988) and heavy metals (Vreman, et al., 1988) in livestock because of contaminated feeds is also of potential health importance.

3. Animal feed contamination

Some 1500 million children under the age of five suffer from diarrhea and 3-5 million die per year. Most diarrheal episodes are now thought to be due to foodborne rather than waterborne pathogens (WHO, 1991). Some of these foodborne pathogens, such as Listeria and Toxoplasma are dangerous during pregnancy as infection of the foetus can cause death or serious malformations.
Example In 1985 some 200,000 people were involved in an outbreak of salmonellosis in Chicago caused by consuming contaminated pasteurized milk (Ryan, et al., 1987).

In 1989 UK reported about 32,000 cases of Campylobacteriosis, a leading cause of foodborne disease (Public Health Laboratory Services, 1989).

Animal feeds composed of meals partly of animal and partly of vegetable origin have shown to be contaminated with *Salmonella* and *Campylobacter*. Animals fed on such feeds in intensive breeding units shed large quantities of pathogens in their feces that contaminate the wet surfaces of slaughter houses, meat processing and distribution plants. The large numbers of these carrier animals have contributed to the contamination of the environment and to the creation of infection cycles of foodborne diseases (WHO, 1991).

4. Livestock wastes

Livestock waste is increasingly discharged into rivers, rendering them hazardous as water sources. It is also used as fertilizer for field crops, vegetable gardens and fish ponds. Parasites are spread from the waste to people who handle fish and prepare or consume raw food. Slurry disbursed on land in hot climates aids the rapid growth of pathogens responsible for foot-and-mouth disease, tuberculosis and brucellosis. Heavy metals in slurry are absorbed by vegetables.

Domestic exposure to poultry and to farm animals predisposes to bacterial diarrheas predominantly due to *Salmonella* and *Campylobacter* species (Grados, et al., 1988). The animals frequently contaminate drinking water supplies.
Example

Abattoir workers in Holland associated with the pork industry have a 1500 times higher chance of getting meningitis associated with *Salmonella* infection than other workers (Arends & Zanen, 1988).

Cryptosporidial infection is an emerging cause of diarrhea among children and immuno-suppressed adults (Rush, 1987; Wittenberg, et al., 1987). Contamination of drinking water with animal fecal matter is an important source of infection. Abattoir workers are also at risk.

Contact with poultry (Grados, et al., 1988) and an environment contaminated with animal fecal matter increases the transmission of *Salmonella* and *Campylobacter* to humans (Moelbak, et al., 1988). The *Salmonella* carrier state is common in otherwise healthy poultry: 16% of chickens and 12% of ducks (Kotova, et al., 1988). The waste water discharges from poultry farms can carry heavy loads of these microorganisms (Stelzer, et al., 1988).

5. **Other Zoonoses**

Several communicable diseases can be increased by the importation of exotic breeds of livestock or the intensification of livestock production. Pigs are hosts of many serious zoonoses. See Irrigation, for an example of JE associated with pig breeding and rice production.

The three most important zoonoses carried primarily by cattle are anthrax, brucellosis and bovine tuberculosis. Brucellosis is a severe and incapacitating zoonotic disease important both where unpasteurised dairy products are consumed and as an occupational hazard of livestock and meat industries. Transmission is by direct contact between animals and man. Livestock movement is of particular concern. In areas where pastoralism is common many hospital patients who are treated for malaria or typhoid fever may actually have brucellosis. No information has been obtained regarding the importance of brucellosis in livestock development projects. Trichinosis is an important disease which is carried by domestic pigs.
Q Fever is emerging as a public health problem in areas of sheep, cattle rearing and dairy farms (Lang, 1989). Human infection is usually through inhalation and abattoir workers are especially at risk (Sawyer, et al., 1987; Somma-Moreira, et al., 1987).

Example In 1971 domestic pigs were imported into West New Guinea from a country in which cysticercosis (due to tape worms) was endemic in pigs and people. The parasite was absent from New Guinea. In 1974 there was an epidemic of severe burns among the Ekari people which was attributed to epileptic fits causing people to fall into fires. The fits were correlated with cerebral cysticercosis infection. The infection spread rapidly and was difficult to control due to husbandry practices and this is believed to have caused considerable economic loss (Gajdusek, 1978; Gunawan, et al., 1976).

The present global distribution of cystic hydatid disease (due to Echinococcus granulosus) is associated with the widespread importation of sheep and dogs (Thompson, 1979).

6. Food Security and Pastoral Nomadism

See also Food Security and Agriculture.

Nomadic pastoralists typically occupy the drier, poorer, more fragile and peripheral lands. They are often cut off from the political process and from access to important social infrastructure. Development projects often have the objective of sedentarization. They frequently fail, or cause irreversible environmental degradation. Provision of water supplies is often a priority. Rainwater dams can provide foci of schistosomiasis transmission. Boreholes can cause overgrazing. Human and livestock population densities can soon be raised above carrying capacity. Food security is determined by animal ownership and the fulfilment of social obligation through animal exchange. Environmental degradation reduces food security and the buffering mechanisms that enable the community to withstand droughts and other disasters. Nomadism has a sound ecological basis and the health of nomads is closely associated with the health of their environment.
Commercial development of their lands pushes nomads into drier areas or denies them grass and water, increasing their marginalization. For example, more than 20,000 nomads were displaced from the Awash Valley in Ethiopia while 100,000 labourers and managers migrated from elsewhere to work on irrigated estates. The low population density and mobility of pastoralists often protect them and their livestock from some of the communicable diseases of settlement such as geohelminths and brucellosis (Watson-Jones & Macpherson, 1988). Lack of water may intensify diseases with a direct fecal-oral route of transmission (Kloos, et al., 1981).

Mothers and children are the most vulnerable component of nomadic communities. Small reductions in nutritional intake may impair their health and increase their susceptibility to communicable diseases (Canadian International Development Agency, 1988).

Small-scale livestock development projects can provide a vehicle for improving mother and child care and introducing family planning programmes by gaining the confidence of the community (King, 1988). The disadvantages of permanent settlement must be balanced against the better access to improved health services in settled communities.

7. Non-Communicable Disease and Livestock

Dairy farming has been associated with increased prevalence of farmer's lung disease. Risk factors include working long hours in enclosed spaces exposed to organic matter.

K. Agricultural Processing Industries

Industrial development is often associated with the agricultural sector where commodities such as tea, coffee, sugar, jute and pyrethrum are processed. Such processing plants expose labour to silica dust, a variety of allergens and spore contaminants that can cause or aggravate lung disease (Blanc, 1984; Yach, et al., 1984; Ye, et al., 1988).

Women form a high and poorly paid proportion of such labour. There is evidence that the prevalence of chronic respiratory symptoms is higher in women workers, although they are usually non-smokers (Zuskin, et al., 1979). Exposure to tobacco dust causes respiratory, skin, eye and gynaecological problems (Nag Anjali, 1986). Protective clothing is often not provided. Rice millers in Malaysia suffer from acute and chronic
irritation of the eyes, skin and upper respiratory tract; allergic responses such as nasal catarrh and asthma; and lung changes associated with dust induced lung disease (Lim, et al., 1984).

Examples of occupational hazards associated with agricultural processing

<table>
<thead>
<tr>
<th>Produce</th>
<th>Exposure</th>
<th>Health Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beedi cigarettes, India</td>
<td>tobacco and bad posture</td>
<td>postural problems and poisoning</td>
</tr>
<tr>
<td>Coir, India</td>
<td>heavy dust</td>
<td>dermatitis, hyperkeratosis, respiratory disease</td>
</tr>
<tr>
<td>Cashew nut, Kerala</td>
<td>fumes and corrosive liquids</td>
<td>dermatitis, abscesses, boils, respiratory disease</td>
</tr>
<tr>
<td>Rice</td>
<td>dust</td>
<td>acute and chronic irritation of eyes, nose, lungs and skin</td>
</tr>
<tr>
<td>Pineapples</td>
<td>acidic fruit juices</td>
<td>dermatitis</td>
</tr>
<tr>
<td>Textiles</td>
<td>dust</td>
<td>respiratory disease</td>
</tr>
</tbody>
</table>

Large quantities of water are used for agricultural processing and organic contaminants may be discharged into surface waters that are used for domestic supply. Post-harvest processing of agricultural produce can cause more severe river pollution than discharge of raw sewage (Agarwal, et al., 1981). The effect of discharges on downstream communities and fish is seasonal. Much produce is processed during the dry season when temperatures are highest and river flow rates are lowest (Cairncross & Feachem, 1983).

Textile processing produces large quantities of air-borne fibres that cause chronic lung disease, such as byssinosis in cotton workers. This can reactivate latent tuberculosis.

Example

Raw silk processors are exposed to a dust derived from the gum which binds silk strands together. In Sri Lanka occupational asthma was associated with degree of exposure to this dust (Uragoda & Wijekoon, 1991). In China, pneumocoriosis was reported in silk workers (Tie-min, 1990).

Stored food products are susceptible to contamination by mycotoxins, such as aflatoxin. These are produced by fungi at specific conditions of temperature and humidity (WHO, 1979). Storage of produce in plastic
bags is especially dangerous. The many adverse effects can include acute fatal poisoning, immuno-suppression and long term risks of liver cancer (Hendrickse, 1991). Aflatoxin exposure is suspected to be a common cause of kwashiorkor, in association with protein-energy malnutrition (Hendrickse & Maxwell, 1989). The toxin is an extremely stable molecule that is unaffected by cooking, fermenting or pickling. There is no reliable method of decontamination. The fungi can infect growing crops as a consequence of pest damage and produce toxins before, during or after harvest. Outbreaks of aflatoxicosis are common in farm animals and the toxins can carry over to meat and milk. Aflatoxins cross the placenta and are excreted in mother's milk (Maxwell, et al., 1989). Powdered milks may also contain aflatoxins. Occupational exposure occurs in workers of stored products.

Example

An outbreak of acute fatal liver disease in India was associated with ingestion of heavily aflatoxin-contaminated maize. Geographical variation in liver cancer prevalence has been associated with daily aflatoxin intake (Hendrickse, 1991).

The immuno-suppressive effect of aflatoxins may reduce the effectiveness of immunization programmes and increase susceptibility to communicable diseases such as measles and HIV. Animal experiments provide evidence of interactions between malaria and aflatoxins (Hendrickse, et al., 1986; Young, et al., 1988).

The export of stored food products by developing countries to industrialized countries is jeopardised by mycotoxins. Products are tested on arrival and may be condemned. Turkish fig exports to the EC were affected in 1989. There are reports of condemned foodstuffs being resold to poorer countries. Emergency food relief supplies can also become contaminated while awaiting trans-shipment.

Listeriosis, caused by the bacteria Listeria monocytogenes is of great concern to the food industry. The bacteria can be found in a variety of dairy products, leafy vegetables, fish and meat products. It can grow in refrigerated foods and is heat resistant. Those predisposed to listeriosis include the immuno-compromised, pregnant women and their foetuses. A recent outbreak in California was linked to the consumption of
Mexican-style soft cheese and involved more than 300 cases, 30% of which were fatal (Farber & Losos, 1988). Meningitis, spontaneous abortion and septicaemia are the primary manifestations of the disease (Farber, et al., 1988). The introduction of a refrigerated food industry could increase incidence.

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Provision of energy has many direct and indirect benefits to health. For example: electricity is used in refrigeration for vaccines and fossil fuel is used in fertilizer manufacture to enable increased food production.

There are three recent major reviews of the negative health impacts of the energy sector (Cooper Weil, et al., 1990; WHO, 1983; WHO, 1991b). This review focuses on fossil fuels, biomass fuels, geothermal and hydropower. (Nuclear power is not included).

The WHO World Commission on Health and the Environment (WHO, 1991b) identified the following four priority areas for immediate action:

- Indoor air pollution from biomass and coal combustion;
- Exposure of large urban populations to high levels of ambient air pollution;
- Serious accidents associated with extraction, storage and power generation;
- Global climate change (outside the scope of this review).

A. Fossil Fuels

Fossil fuels account for most of the global industrial energy sources. The health hazards of fossil fuel use can be classified according to time of onset of the potential illness or disability or according to the stage in the fossil fuel cycle (see table). The long term mutagenic and carcinogenic effects are the most serious and most uncertain.
Example
In London, 1952, when the atmospheric concentration of sulphur dioxide and suspended particles exceeded 1000 ug/m³ the total daily mortality rate doubled. Similar effects have been reported from Japan (WHO, 1979).

There was a rapid increase in upper respiratory infection near the Batangaas coal-fired power station, Philippines, during the eighties (Environmental Management Bureau (Philippines), 1990).

In China, burning high fluoride content coals contributes to endemic fluorosis affecting large populations (PEPAS, 1991).

The pollutants emitted by the combustion of fossil fuels have an impact on the health of nearby communities and are also dispersed over large areas. They include sulphur dioxide, nitrogen dioxide, carbon monoxide, particulate matter, ash and carbon dioxide. Carbon monoxide accumulates in buildings when combustion chambers and exhaust ducts are not properly sealed. It impedes oxygen transport leading to neurophysiological and cardiovascular impairment. Nitrogen dioxide impedes respiration. Oxides of nitrogen react with hydrocarbons to produce photochemical smog that cause eye irritation and acute respiratory disease.

High concentrations of sulphur dioxide and particulates increase respiratory disease and can increase mortality. Hydrogen sulphide exposure is an occupational hazard and in high concentrations causes acute intoxication and eye ailments ("gas eye") (WHO, 1981).

Example
Gas pipe explosions in Mexico killed 58 people in 1978. In 1984 452 were killed and 4248 were injured. In the same year 500 were killed in Sao Paulo, Brazil (Covello & Frey, 1990).

The relative health risks of coal- versus oil- based electricity generation are complex. The occupational risks of deep coal mining are well established and include accidents and respiratory disease. See Mining. The by-products of coal and oil processing include chemicals that can
cause skin tumours and dermatitis. The ash residue from coal burning contains concentrated toxins such as heavy metals. The emissions from coal-fired plants are harder to contain than those from oil-fired power stations. Small to medium sized power stations are more dangerous than large ones because they have lower stacks.
Health hazards associated with the fossil fuel cycle (WHO, 1983)

Definite or major effects

Classification according to time of onset of illness or disability

<table>
<thead>
<tr>
<th>Health hazard</th>
<th>Acute</th>
<th>Intermediate</th>
<th>Long-term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle accidents</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Fires and explosions</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Work accidents</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Eye irritation</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Respiratory tract irritation and impairment</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Aggravation of respiratory and cardiovascular conditions</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Neurophysiological impairment</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Odour and noise</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Psychological effects</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Skin irritation</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Specific acute toxicity</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Effect of organic and inorganic pollutants</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Effects on human reproduction</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Carcinogenicity</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Mutagenicity</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Consequences for health of ecological damage</td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
The emissions from petrol or diesel engines are an important source of air-borne pollutants and contribute to photochemical smog.

Urban air pollution from burning fossil fuels regularly exceeds the health-related guidelines established by WHO in over half of the cities that are monitored (WHO, 1991a).

Many cities suffer from thermal inversion smogs made worse by the extensive use of wood and coal for domestic purposes. This is associated with the spread of tuberculosis and other respiratory diseases.

Noise and vibration are an occupational hazard of power plants that affect general well-being, hearing and vision. Workers at the Cebu power plant, Philippines, are exposed to noise levels of 102dB A, which is above the permissible limit set by the Department of Labour and Employment (National Power Corporation, 1989).

B. Biomass Fuels

Biomass fuels are the primary fuel for most domestic users in poor communities. They include wood, logging wastes, animal dung and crop residues. There are important health hazards associated with the collection and burning of biomass. Occupation health hazards are identified with long and exhausting journeys bearing heavy fuel loads. See forestry. Exposure to smoke causes respiratory and eye irritation and associated disease. Associated health hazards include:
(i) Chronic obstructive lung disease.
(ii) Heart disease, particularly cor pulmonale.
(iii) Acute respiratory infections particularly in children.
(iv) Low birth weight due to maternal exposure and associated with a range of perinatal and infant ill-health.
(v) Eye disorders: conjunctivitis, blindness.

Women and infants are the most vulnerable groups. Household cooking on an open fire has been described as the largest single occupational health problem of women in the world (WHO, 1991b) (Smith, 1987).

Example

A study in Nepal in 1986 indicated that improved cookstoves were effective in reducing the cook’s exposure to health damaging particulates by approximately two thirds and reducing carbon monoxide concentrations by three-quarters in comparison to neighbouring kitchens with traditional cookstoves (Mutere, 1990).

The development and utilization of improved cooking-stoves will reduce this health risk and the associated problem of fuel scarcity (Intermediate Technology Development Group, 1991).

C. Geothermal energy

Geothermal steam tapped from depths of 3,000m carries dirt, impurities, hydrogen sulphide and radon-222, a radioactive gas. Significant quantities of toxic elements, such as arsenic, chromium, copper and mercury, accumulate in the sludge (National Power Corporation, 1987). The sludge may be discharged into rivers and accumulate in the fish food chain. Exposure to non-condensing gases is the most serious public and occupational health concern (Anspaugh, 1981).

The hazards of drilling geothermal sources include violent explosions and emissions of large quantities of hydrogen sulphide.
Appendix 7

D. Hydropower

See also two reviews of water resource development in South East Asia (Harinasuta, et al., 1978; Sornmani & Harinasuta, 1988).

The direct risks of hydropower are largely concerned with the traumatic injury associated with large construction projects. See Construction (Appendix 5). The health of the often large numbers of people who must be resettled is an important cause for concern. See Resettlement (Appendix 5). Finally, there are important health hazards associated with the large bodies of surface water that are stored, diverted and discharged during construction and operation.

The communicable diseases most often associated with hydropower are malaria, schistosomiasis and onchocerciasis.

1. Malaria

Large engineering projects involving rivers have frequently led to explosive malaria epidemics during construction. The main cause is the increase in water-filled excavations and diversions.

Mosquitoes often breed in the shallow, sheltered margins of reservoirs (Ripert & Raccurt, 1987). However, there is much variation between regions. In Africa, malaria mosquito breeding is also associated with drawdown that exposes numerous puddles on gently sloping shores. In Asia, downstream pools in the river bed tend to be more important.
Example

The diversion of the Thenpennai River for a 10 km stretch near the Sathanur Dam, Tamil Nadu, exposed a rocky river bed in which mosquitoes could breed. There was a resurgence of malaria (Tewari, et al., 1984).

The natural flow of the Mahaweli river, Sri Lanka, was interrupted by dams and diversions. Stream pools formed in the dry river bed which bred malaria mosquitoes. A human reservoir of infection was created by circulation between lowland resettlement sites and riverine villages (Wijesundera, 1988).

2. **Schistosomiasis**

Schistosomiasis and, to a lesser extent, dracunculiasis are commonly reported hazards of reservoir construction. There is considerable regional variation. The large reservoirs usually associated with hydropower have many sheltered, shallow inlets where aquatic vegetation thrives. Informal settlements of fishers are frequently a vulnerable group.

An increase in schistosomiasis has been observed simultaneously across the whole of Africa where water development has taken place. The increases in prevalence have often been dramatic and the intense haematuria in children has caused public alarm (Hunter, et al., 1982). By contrast, in Asia schistosomiasis is contained within small endemic foci and dam development has often proceeded without outbreaks of the disease.

3. **Water pollution**

Water outflow from large hydropower schemes is often erratic or polluted. Pollution reduces access to potable water for communities that rely on the river, promoting transmission of waterborne diseases. Reduced stream flows alter the replenishment rate of aquifers, affecting domestic water supply, and promoting saline intrusion on to irrigated lands. Reduced nutrient flows disrupt fisheries and reduce food security.
E. Electricity Transmission

There is current concern about the effects of electromagnetic radiation from high tension power lines, but no conclusive information.

There are reported cases of electrocution among workers in contact with metal pipes which have become live through accidental contact with power lines (Helgersen & Milham Jr, 1985).

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APPENDIX 8 INDUSTRY

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Industrial activity affects the health of two vulnerable groups:

☐ the work force, through occupational safety and health;
☐ the general population, through industrial pollution.

In addition, catastrophic accidents can affect both groups. There are several recent reviews (Cooper Weil, et al., 1990; Covello & Frey, 1990; WHO, 1991). Related issues include: siting and zoning, control of industrial pollution, management of hazardous waste, disaster preparedness, and urbanization.

There are many important policy issues that are outside the scope of this review. These include: the establishment of "pollution havens", the export of hazardous processes from developed to developing nations; the deliberate under-assessment of hazards and flouting of regulations; and the inability of governments to monitor and enforce. Many governments lack the resources for adequate risk assessment and risk management.

Example

The increased regulation of the asbestos industry in many developed nations has caused multinationals to move production to developing nations. One such plant was described in 1981 in which the workforce were not protected from asbestos fibre (Covello, et al., 1990).
A. Industrial Pollution

Industrial pollution of air and water may be due to normal or accidental discharge. The health risk is determined by the nature and amount of emission, local geography, climate and community location.

Example: In Utah, USA, changes in air-borne particulates associated with the closure and reopening of a steel mill between 1985 and 1988 was strongly correlated with hospital admission rates for various respiratory diseases (Pope, 1989).

Proximity of residential neighborhoods to USA chemical plants was significantly associated with respiratory complaints in school children (Spengler, et al., 1990).

Accidental discharges of acute poisons can occur when plants malfunction. The primary safeguard is proper plant maintenance and operation, including containment procedures, trained staff and emergency response plans. Additional safeguards include land zoning policy based on the known area of fallout of toxic emissions. Unfortunately, the potentially hazardous land around chemical plants is often settled by the urban poor. Enforcement of land zoning legislation, where it exists, is difficult. Foreign exchange restrictions often limit the availability of spare parts.

Example: The accidental release of methyl isocyanate at Bhopal, India led to over 6,000 deaths and many more injuries. Settlement of land adjoining the plant was an important factor contributing to the magnitude of the disaster. There is evidence that lower operating standards were employed than the international standard (Weir, 1988).

Normal discharge of atmospheric pollution in many urban areas can be so high that 70% of populations may be living in areas where air quality conditions are a hazard to health (Cooper Weil, et al., 1990; Sobral,
Threshold risk levels vary with climate, altitude, nutrition and infections. Industrial waste is often released into water bodies that serve as water sources for large populations. In addition, fish stocks may become heavily polluted with heavy metals and other chemicals affecting fishers and consumers. National protection agencies may lack the resources for regulating discharges. Factories are relocated from industrialized to industrializing nations to evade legislation.

Example

Respiratory ill-health in Sao Paulo, Brazil, is significantly associated with pollution levels. Poor socio-economic conditions aggravate the problem (Sobral, 1989).

The industrial district of Cubato, Brazil, has 23 major industrial plants and many smaller operations. Serious health problems include elevated neonatal mortality rates, birth deformities, and a high prevalence of respiratory disorders. These are associated with high levels of water and air pollution (Findley, 1988; Pimenta, 1987; Thomas, 1981).

During the 1950’s, the discharge of mercury into Minamata Bay, Japan, poisoned fish stocks and led to over 2,000 cases of serious neurological disease (Third World Network, 1989).

At Guadalajara, Mexico, April 1992, a 2km length of sewer contaminated with alkanes (such as petrol) exploded, killing more than 200 and injuring more than 800 people (International press).

Industrial activities tend to be concentrated in zones where there is already a concentration of commercial activity, including supply markets, communications technology and transport. In developing countries the zones are in or near major cities, creating new health hazards.
B. Hazardous Waste

The cost of producing synthetic chemicals is sometimes less than the cost of their ultimate safe disposal. There is rarely adequate provision for the disposal of hazardous waste. A "cradle-to-grave" approach has been advocated that encompasses generation, reduction, treatment, recovery, transport and disposal. See also Mining (Appendix 12).

Example

A study in China found dangerous levels of cadmium from a tungsten ore dressing plant in irrigation water. The community was ingesting the cadmium through agricultural crops. The average intake was 367-382 ugms per day. Many of the community had attributable clinical symptoms (Cai, 1990).

C. Occupational Health Hazards of Industry

See also Mining and Construction. Occupational safety and health is too large and complex a subject to be covered adequately in a broad review. It requires specialist treatment. There is widespread agreement that little information is available from developing countries. The World Bank's Occupational Health and Safety Guidelines (World Bank, 1988) should be consulted. There is a recent review in Proceedings of the International Symposium on Health Impact of Rapid Industrialization and Urbanization in Asia and the Pacific and its Public Health Activities (Suzuki & Ohtsuka, 1990). Three standard rates are used as indicators.

\[
\begin{align*}
\text{Frequency rate} &= \frac{\text{number of disabling injuries}}{\text{employee hours of exposure}} \times 1,000,000 \\
\text{Severity rate} &= \frac{\text{total days charged}}{\text{employee days of exposure}} \times 1,000 \\
\text{Death rate} &= \frac{\text{number of deaths per 1,000 workers}}
\end{align*}
\]

A wide range of health problems has been associated with industrial processes in industrialized nations. Ship builders in Italy, for example, have a high prevalence of respiratory disorders due partly to inhaling welding fumes (Gennaro, et al., 1990). Similar problems occur in
developing nations but with poorer control and documentation (Cooper Weil, et al., 1990). Priorities are rarely established, for example pollution by pesticide may receive undue emphasis. Where occupational health standards are implemented, the larger industries are likely to receive the attention. Responsibility for OHS is often divided between many agencies. These may include the Labour Department, Ministry of Industry, Environmental Protection Agency and the Ministry of Public Health.

Occupational diseases are regularly under-reported in some developing member countries to avoid costly preventive measures. The annual rate of accidents causing disabling injuries to workers is 21-34% in developing countries, compared with 3% in the UK during the 1970's (El-Batawi, 1981).

Occupational health and safety is well developed in Singapore (Phua, 1990). There are 1.25M workers in over 10,000 factories. Associated medical staff include: 260 physicians, 200 nurses, 10 industrial hygienists and 230 safety officers. The commonest recorded diseases are noise-induced deafness and dermatitis. The average frequency rate is 4. In the ship-building industry it is 14.

Example Thailand is industrialising rapidly and had over 10,000 factories in 1988. Industrial accident claims have doubled in the last 10 years. Accidents and poisonings of all kinds were the second leading cause of adult mortality in 1985. There is a single centre for toxicology producing far fewer graduates per year than are needed (Muangman, 1990).

The majority of the workforce may be engaged in small-scale industries with distinct occupational hazards that are not amenable to regulation or inspection. Child labour is a continuing and growing problem. A survey indicated that workers in small industries have a greater risk of suffering from toxic effects, or from fully developed occupational disease, than those in large industries (El-Batawi, 1981).
Example

Clubbing of the fingers and toes is a sign of chronic hypoxia. The symptoms were noted in match factory workers in Fiji exposed to Rhodamine B dye. The affected individuals did not use gloves or shower after work (Dharmawardene, 1991).

Extraction of scrap lead from car batteries is an important small industry. Many of the workforce may have chronic lead poisoning. Lead dust levels in some enterprises may be 1,000 times above threshold limit values. Face masks and protective clothing are often not provided or not properly used (Sakari & Mubisi, 1983).


Noise-induced hearing loss is an increasing problem of industrialization and urbanization. Besides factories, the problem occurs in mining, forestry and transportation. Excessive noise interferes with communication, disrupts sleep, diminishes job performance and has other psychological effects. Exposure to excessive noise levels above 90dB A for periods of greater than 10-15 years can lead to permanent hearing loss of the frequencies used in speech. Extremely high noise levels above 145dB A peak, such as produced by explosions or gun fire, can lead to immediate severe and permanent loss of hearing, a condition known as acoustic trauma (Smith, pers. comm.).

Example

In Thailand, weavers exposed to 100dB A had more hearing loss than other textile workers (Chavalitsakuchai, et al., 1989). Forty per cent never used ear protection. In a plastic bag factory 80% of workers exposed to 98dB A never used ear protection, mainly because none was provided (Chavalitsakuchai & Shahnaz, 1989).

Many occupational hazards, including hearing loss, are compounded by exposure to various industrial chemicals such as heavy metals and
organic solvents. When two or more hazards are present, their combined effect should be given primary consideration (WHO, 1983).

Example The combination of chemicals, noise and heat is a particularly serious hazard of the electroplating and semiconductor industries (WHO, 1983).

Heat is an additional source of hazard. High temperatures impose a thermal load on workers, reducing productivity and increasing accidents. Industrial processes using heat also create a fire hazard or cause the explosion of gases and dusts in the confined spaces of factories.

Exposure to heavy metals occurs in many industrial processes including welding, smelting, engraving, lithography and photography (Nemery, 1990). Women are especially at risk (Rom, 1976). Chronic exposure to low concentrations increases the incidence of stillbirth, interrupted pregnancies and other complications of pregnancy including foetal damage (Hemminki, et al., 1983).

Example The incidence of miscarriage in Europe is higher among women working in the chemical sector (Marinova, 1978).

Electric arc welders are exposed to damaging levels of ultraviolet radiation (Diffey, 1990; Hanke & Karsten, 1990). Traumatic eye injuries are common in the metal-working industries (Reesal, et al., 1989), especially grinding and welding. Simple methods of eye protection are available but frequently are not used (Hanke, et al., 1990).
Example A study of welders in the USA determined that a doubling of exposure to UV-B radiation led to a 60% increase in the risk of cortical cataract (Taylor, 1990).

A European study noted that 64% of workers with eye injuries had not been using any form of eye protection, even where it was mandatory. 20% had sustained two or more eye injuries within twelve months (Bakholdt & Illum, 1990). A UK study noted that 70% of patients attending an eye clinic had sustained the injury at work, 1.8% required hospitalization (Macawen, 1989).

Income generating projects for the poor are often a component of development assistance. These are expected to have a beneficial health impact through increased income. However, the associated occupational health hazards should be considered.
Example

A survey of workers from small industries in Korea in 1975 concluded that: 42% from lead smelter and accumulator factories had signs of lead poisoning; 10% using solvents had suspected intoxication; 18% of all workers had symptoms of occupational diseases. Tuberculosis prevalence was up to 26% in pneumoconiotics, compared to 3% in the total working population (El-Batawi, 1981).

In Korea, 1987, 71% of reported occupational disease was coal miners lung disease, 28% was noise induced disease, the remainder was due to lead, solvent, chromium, mercury and other chemical poisoning. Noise levels were highest in the shipbuilding, automobile, steel and mining industries. The case detection rate was about half that of Japan (Paik, 1990).

Injury frequency and severity rates in Korea have been very high but may now have started to fall following an Act of 1981. In 1987 the compensation scheme related accident death rate was 0.033%.

In 1988, Korea imported 80,000 tons of asbestos. Air samples of fiber concentrations in associated manufacturing industry were well above acceptable thresholds (Paik, 1990).

Serious health hazards abound in small factories employing primarily women and among women doing piecework at home (Cooper Weil, et al., 1990). Women working in factories are less likely to breast-feed their children, contributing to infant diarrhea. Women are often employed in export industries such as electronics that require accurate repetitive tasks. The enforcement of occupational health standards is often particularly lax in export industry, resulting in acute poisoning, chronic conjunctivitis, eye-strain, migraine, arthritis, lung disease and fatigue. These hazards are offset by higher incomes that may reduce the prevalence of poverty-related diseases. The risks of congenital abnormalities associated with handling toxic chemicals remain largely undocumented.

Many countries do not possess the staff or technology required to monitor levels of contamination in the air, water or workforce.
Metal ores and their natural contaminants, such as arsenic and lead, frequently receive primary processing and smelting in the country of origin. Problems of acute arsenic poisoning and long-term carcinogenic risk should be addressed.

D. References


APPENDIX 9
TRANSPORT AND COMMUNICATION

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A. Communicable Disease

Road and rail projects built in flat terrain and valley bottoms, especially in areas of seasonally heavy rainfall and clay soils, are often elevated on earthen berms above ground level (Ault, 1989). Seasonal drainage patterns may be altered or blocked. Such routes built along hillsides, though not elevated above the grade, may block rainfall runoff patterns. Without proper placement of culverts, pooling of water is inevitable. Large volumes of soil extracted during construction create flooded borrow pits. Malaria mosquitoes proliferate in the surface waters and the transmission of malaria may be intensified.

Example

Increased malaria has been documented for road construction in the Amazon Basin, Liberia and Kenya. In 1974 some 50% of the malaria in Amazonia was linked to the narrow area of influence of the Transamazon Highway (Ault, 1989; Coimbra, 1988).

Road-side storm water drains in coastal tropical towns and cities are often the sole disposal point for waste. The drains become blocked by solid waste, provide breeding sites for mosquitoes that breed in foul water and transmit filariasis. Spread of parasitic diseases whose ova are passed in excreta is strongly associated with the use of roadside ditches as latrines. The excreta may be washed downstream to nearby moist places or water pools where transmission occurs (Meakins, pers. comm.).
Example

Filarial is endemic in coastal Indian towns. As part of a road upgrading programme, curbside L-shaped drains were replaced by deep U-shaped open drains. The new drains were soon filled with rubbish. Because they were much more difficult to clean out than the old drains mosquito breeding increased.

Unplanned settlements, resthouses, food stalls and garages proliferate along the course of new roads. Often they are situated near ponds where vector mosquitoes and snails breed. The residents of such settlements may have no access to health care facilities. Such informal settlements may serve as a focus for STD transmission by long distance truck drivers and taximen (Arya, et al., 1988; Carswell, 1987).

By contrast, road improvements can greatly improve access to health facilities for poor rural communities. Roads simplify the circulation of health workers improving case finding, treatment and follow-up for communicable disease control such as tuberculosis. They also improve the response to emergencies such as famine.

Road projects enable malaria and other communicable diseases to spread to previously uninfected areas. Roads change the patterns of human mobility and circulation, enabling vulnerable people to enter endemic regions.

Workers engaged in the construction of roads or laying of telephone lines through undisturbed countryside may contact natural disease foci. An example would be scrub typhus in Southeast Asia.
Seaports are a traditional focus for STD transmission associated with sailors, military personnel and tourists (The Panos Institute, 1988).

Example

A survey in Manila found that 5 out of 6 people seropositive for HIV were sex workers connected to military bases (The Panos Institute, 1988).

Air travel provides an ideal opportunity for insect disease vectors to migrate to new regions unless strict disinfection measures are maintained. However, the recent spread of the "Asian tiger" mosquito into the USA is attributed to used tire imports.

B. Traumatic Injury

There appears to be a strong link between development and motor-vehicle related mortality (Wintemute, 1985). Road accident fatality rates per licensed vehicle are generally higher in developing countries and the rate has worsened over the past decade (Jacobs & Cutting, 1986). Fatality rates appear to reduce with increasing vehicle ownership, apparently as a result of behaviour modification (Jacobs, 1986).

Road users frequently disobey road signs and markings. This is due in part to lack of knowledge of safety rules and regulations and lack of concentration due to tiredness or use of stimulant drugs. Some 15% of drivers may be under-age and 60% may not have passed a driving test (WHO, 1989). Poor maintenance and gross over-loading of vehicles is common. Accident rates are also associated with the quality of highway engineering (Jacobs, 1986). High benefit-cost ratios have been demonstrated in developed countries from low cost remedial measures. There is insufficient equivalent information from developing countries.
Example

One unpublished report tried to identify the financial savings attributable to road upgrading projects by including substantial sums to reflect pain, grief and suffering from traffic accidents (Jacobs, 1986).

Traffic accidents in Papua New Guinea were estimated to cost 1% of GNP in 1978 (Havard, 1978).

There are opportunities to improve safety. For example, open-backed vehicles used for passenger transport are a major source of transport injuries in Papua New Guinea. Import duties favour these in place of safer enclosed vehicles (Nelson & Strueber, 1991). A survey indicated that only about 10% of front-seat car occupants in PNG wore seat-belts (Lourie, 1982).

Fatality rates per person injured improve significantly with increasing medical facilities. Hospitals near main routes may have most surgical beds occupied by road accident victims who have to remain for extended periods.

New and upgraded roads create a particular hazard for pedestrians. Very often rural people have no experience of fast moving traffic. They may wander across unfenced roads sometimes driving herds of animals. They may have no conception of the sort of distance required for a fast moving vehicle to come to a stop.

C. Shipping

The World Bank’s Occupational Health and Safety Guidelines (World Bank, 1988) notes that there are many complex safety issues associated with fishing and the design of fishing vessels. These include asphyxia due to the release of gasses by rotting fish.
D. Other health hazards

Roads built on valley floors may reduce the availability of agricultural land and increase roadside land values. Food prices may rise and food security may decrease.

Many roads in rural areas are unpaved and some are used primarily for the short term extraction of natural resources. The large volumes of dust disturbed by traffic on unpaved roads can be a cause of respiratory disease (Howze & Hughes, 1990).

Example In the Appalachian states of the USA many people live by unpaved roads. Dust particle levels are unacceptably high within 100m of the roadside and aggravate pre-existing respiratory disease (Howze, et al., 1990).

Motor vehicles are the largest single source of several important air pollutants (Walsh, 1991) (See also Fossil Fuels, Appendix 7). There are over 500M vehicles on the world's roads and the annual growth rate averages 3%. Heavy duty trucks and buses are an increasingly important proportion of the total. The emissions contribute to eye irritation, headaches, heart disease, upper respiratory illness, asthma and reduced pulmonary function. Technologies are available to reduce these emissions cost-effectively. Fuel quality is an important determinant. The increase in number of vehicles offsets the beneficial effect of emission control. Many Asian cities still permit lead in fuels and import vehicles with engines requiring such fuels. Atmospheric lead levels are raised and significant quantities of lead are inhaled. Noise pollution is an associated problem.
Example

Exposure of "jeepney" drivers in Manila to total suspended matter, carbon monoxide, sulfur dioxide and lead was above WHO and national air quality standards. The prevalence of chronic respiratory symptoms, chronic obstructive airway disease and reduced lung function was significantly higher than in commuters. Smoking was a contributory factor (Subida & Torres, 1991).

Atmospheric lead concentrations and blood lead levels in Jakarta and Bandung, Indonesia, were twice those of rural counterparts in 1988 (Suzuki, 1990).

E. References


Suzuki, S. "Health effects of lead pollution due to automobile exhaust: findings from field surveys in Japan and Indonesia". *J. Human Ergol.*, vol. 19, pp. 113-122, 1990.


APPENDIX 10 URBAN RENEWAL

See also Transport and Communication.

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A. Urban Development

It has been suggested that very few governments or aid agencies give much attention to cities' environment problems - especially the problems that impact most on the health and livelihoods of poorer groups (Hardoy & Satterhwaite, 1991).

Location and zoning is important for safeguarding health in the urban environment. Schools near to major highways may expose children to excess levels of traffic pollutants. Large distances between home and workplace generate streams of pollution along commuter routes. Concentration of septic tanks at too high a density can affect the quality of drinking water.

Rapid urbanization is shifting the balance of population from rural to periurban environments throughout the Third World. Much of the population increase is due to natural change rather than in-migration. In a few years, some 50% of the world population will be living in cities. Many will live in the "septic fringe". This term includes a large range of housing types such as tenements, boarding houses, illegal subdivisions and informal settlements (Hardoy, et al., 1991).

Urban development projects are usually concerned with water supply, sanitation, refuse collection, housing and roads. The most serious problems regarding impact on human health are due to government failures. There is frequently failure to control industrial pollution. City-dwellers are often denied the basic infrastructure and services essential for health (Hardoy, et al., 1991).
Example

Increased dust levels in poor areas coupled with overcrowding predisposes to outbreaks of meningococcal meningitis (Moore, et al., 1988; Salih, et al., 1988; Schwartz, et al., 1989).

The annual average total particulate levels largely due to traffic in Metro Manila have increased in 20 years from 60-80 to 200-250 ug/m³ and frequently exceed WHO guidelines (Subida & Torres, 1991).

Official urban health statistics often fail to indicate that the health and nutritional status of the urban poor is worse than their rural counterparts. In the crowded conditions of urban slums there are epidemics of communicable disease, such as cholera and meningitis. Much infant mortality is due to diarrhea exacerbated by malnutrition.

Poor urban communities have very inadequate access to health care, especially when they are injured at work, fall ill from pollution or require emergency services. Communities built on steep slopes or waterlogged sites with narrow alleyways are inaccessible to ambulances and fire engines (Hardoy, et al., 1991). Fire, building collapse, landslide and wounds are frequent occurrences in such neighbourhoods (Goldstein, 1990).

The urban poor represent a vast and cheap labour supply. They participate actively in and are essential to the urban economy. Their well-being can ensure the stability of government (Harpham, et al., 1987).

Some 70% of households in urban slums are headed by women. Young children must often be left unattended while their mothers work. Childhood malnutrition is common and can be helped by provision of land for vegetable gardens, however small.
Example

In Manila owners of unused land were obliged to cultivate or forfeit it. Community gardens were established. One garden supplied 800 squatter families with 80% of their vegetables on 1500m² of land (Harpham, et al., 1987).

B. Low Cost Housing

The linkage between housing and health is widely recognised but hard to evaluate. In most countries, the health authorities have not taken much part in urban planning (Cooper Weil, et al., 1990). Little, if any, attention by architects and planners is paid to the need for disease control and public health programmes (Hardoy, et al., 1991). Measures to provide housing for the urban poor include site and services programmes and slum upgrading programmes. These programmes often meet with mixed success because of their complex administrative requirements. On the one hand they legalise the occupation of land creating a sense of permanency in which infrastructure and services can develop. On the other hand, inflexible regulatory and standard-setting measures, designed to promote a safe and healthy housing environment, may be unaffordable. They may actually inhibit improvements in sanitation or in extension of services.

House design and improvement has an important role in the control of vector-borne diseases such as malaria. There are many innovations. Poor design in low cost housing schemes can lead to the proliferation of vector-borne diseases. The most common problems arise either through inadequate provision for waste water disposal or through construction on land with a high water table. Lack of storm water drainage can reduce ground stability and increase the sense of insecurity. Low construction costs can be associated with high maintenance costs; the objective should be to reduce both.
Example

The City Corporation of Yangon (Rangoon) built low-cost satellite towns on reclaimed swampy land to accommodate large numbers of squatters. Although protected from flooding by bunds and sluice gates, the ground became waterlogged during the rains. The surface drains were inadequate, mosquitoes bred heavily, and bancroftian filariasis transmission was soon established. Multi-storied blocks of flats were also constructed with good internal plumbing but not connected to the city sewage system. Pools of polluted waste water were formed and mosquitoes proliferated (Macdonald, 1991).

Adequate ventilation of housing is essential for good health. This should include two series of vents permitting cross ventilation to all parts of the building. A recent review of domestic biofuel and health notes that women and children spend prolonged periods in unventilated houses exposed to smoke from cooking stoves. See also Biofuels (Appendix 7).

C. Refuse Disposal

Infrequent collection and rapid decomposition of wastes provide an attractive feeding and breeding site for flies, rats and other scavengers. Human and animal fecal matter or hospital wastes are often mixed with the refuse. Uncollected waste frequently blocks drains where it creates health hazards associated with mosquito breeding and excreta. Vectors and pathogens multiply.

Collection and disposal of waste can consume up to 50% of a municipal operating budget. Frequently only 50-70% of the waste is regularly collected. The problem is organizational rather than technical. Refuse disposal is often a non-profit making business and thus is treated as an unwanted side-effect of development. Attention should be paid to storage, collection, transport, intermediate transfer to bulk transport and final disposal.

Houseflies are important in the transmission of enteric infections, particularly those responsible for infantile diarrhea and dysenteries. Disease transmission by houseflies is greatest where inadequate refuse storage, collection and disposal (leading to increased breeding) is accompanied by inadequate sanitation and hence greater access of flies
to human feces. Refuse must be collected twice per week to prevent fly breeding.

Example

Experimental trials using chemical control methods in Texas and Georgia demonstrated that diarrhea attack rates may be up to 33% higher when houseflies are uncontrolled. Prevalence of the dysentery organism *Shigella* was three-fold higher in untreated areas whilst death rates from diarrhea and dysentery were measurably greater where houseflies remained uncontrolled (Lindsay, et al., 1953; Watt & Lindsay, 1948).

Domestic rats, birds and other scavenging animals act as reservoirs for many organisms transmissible to people, including plague, forms of typhus, leptospirosis, trichinosis, psittacosis and salmonella infection. Chemical control of both houseflies and rodents is not very effective because of widespread resistance. The essential basis of control remains denial of access to food and harbourage, by covered storage and efficient removal.

Once collected in poorly designed or poorly operated disposal sites, refuse may contaminate groundwater with nitrates, heavy metals and other chemicals. Incineration of wastes may pollute the air with particulates and oxides of sulphur and nitrogen. The slag and ashes from incinerators may result in leachates that are rich in heavy metals and other potentially toxic substances (WHO, 1985). Combustible gases will be generated for more than 20 years and these travel under roads and through ducts to create a hazard in buildings.

D. Waste Pickers

The total number of people in Asian cities whose occupation consists of waste recovery and recycling is believed to be several million
and growing (Bubel, 1990; Furedy, 1990). Some 1-2% of the urban population may be so employed.

Example More than 14,000 people are said to live and work on "Smokey Mountain", one of Manila's dumpsites. Jakarta may have over 12,000 waste pickers. More than 40,000 people may gain their livelihood from waste in Calcutta (Bubel, 1990).

Referred to as human scavengers or waste pickers, frequently ignored in urban project plans, their activities may be vital to the life of the city. Many consist of abandoned children and destitute families. They live and work under extensive health risks, which are largely undocumented, and suffer severe exploitation and deprivation. Suggested health hazards include raised levels of infant mortality, hand and leg injuries, intestinal and respiratory infection, eye infection, lower back pain, malnutrition, skin disorders and exposure to hazardous waste (Adan, et al., 1982; Bubel, 1990). Water supply, for drinking and washing, and sanitation facilities are usually very poor at dump sites. Health and welfare facilities are required.

Waste pickers may make a substantial contribution to urban waste management. They may reduce the volume of waste by 10-20%. However, private collection at source may only operate in the wealthy areas where waste contains items of value.

Example The Bank's Integrated Flood Control Projects in Dhaka and Secondary Towns, Bangladesh, is greatly concerned with improved drainage and solid waste management. Feasibility studies note that less than 50% of solid waste will be formally collected. The contributions of waste pickers were not discussed.

Observers agree that the issue of waste pickers cannot be evaded. Their positive role in the management of urban solid waste should be recognised and their lot improved (Furedy, 1990). Legislation against waste pickers is no solution.
E. References


APPENDIX 11 WATER SUPPLY AND SANITATION

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A. Communicable Diseases and Water

See Environmental Health Engineering in the Tropics: An Introductory Text (Cairncross and Feachem 1983) and Sanitation and Disease, Health Aspects of Excreta and Wastewater Management (Feachem, et al., 1983). The diseases associated with water are commonly subdivided as follows.

(i) Water washed. These diseases are prevented by washing and bathing.
(ii) Water borne. These diseases are prevented by clean water supply and sanitation.
(iii) Water contact. Bilharzia and guinea worm are important examples of diseases acquired from water contact.
(iv) Water related. Many insect vectors, such as mosquitoes, require a special kind of water during their immature life stage.

B. Water Supply

Water supply projects often require the intermediate storage of domestic water in small containers and roof tanks. Small containers provide breeding places for *Aedes* mosquitoes that are vectors of dengue fever. Dengue is now widespread in urban areas of developing countries. Roof and ground level tanks in India and the Middle East provide breeding sites for a malaria mosquito and lead to widespread urban malaria. Leakage from water pipes and runoff from standpipe aprons provide additional mosquito breeding sites.
Example

As a result of a dengue epidemic in Bangkok in 1987, some 174,000 people required hospitalization at an estimated cost of $16M. The vector control budget for the same year is said to have been less than $300,000 (White, pers. comm.).

Safe drinking water supply projects are important for the eradication of guinea-worm (dracunculiasis), which is an important cause of morbidity in endemic areas (Muller, 1991). Unfortunately, the boreholes that should help to prevent contamination are often poorly sited and dry up or break down.

Example

In one study, 58% of individuals infected with guinea worm were unable to leave their compounds for a mean of 4.2 weeks. The absentee rate in schools rose to 60% during the transmission season (Muller, 1991).

Increased quantity of water is often more important than improved quality for the control of endemic diarrhea (Cairncross, 1990). Fetching and carrying water is often the role of women. Improved supply may provide extra time for child care and other activities.

Example

Access to public water is limited. In Bangkok and Jakarta about 1/3 of the community buy water from vendors. The price is five times that of piped water (Hardoy & Satterthwaite, 1991).

Communities need convenient access to 30-50 litres of water per person per day. This must be accompanied by concurrent and continuing health education to have a health benefit. Sustainable water supplies require sustainable cultural changes. The cost of sustained water supplies should
be borne largely by the community. Maintained protection of the source and distribution system is also essential. Piped water supplies usually leak and if the water pressure is low the leakage is inwards and the supply becomes heavily contaminated.

Indiscriminate addition of extra taps reduces the pressure and increases the risk of contamination. Inward leakage of contaminants is common wherever the supply is intermittent or undulations in pipework create negative pressures. Chlorination at source is not always effective.

Underground supplies are generally well protected. The slow natural flow of water through earth filters and kills pathogens. Mineral oils are the more serious pollutant, being long-lived, difficult to remove and tainting.

Minerals and trace elements in drinking water are natural and essential. The absence or excess of chemicals such as chlorides and fluorides affects health. Seasonal variation is common. Where groundwater is unpalatable due to excess salts communities may use surface water contaminated with bacteria (Cairncross & Feachem, 1983).

Supply of clean water does not, of itself, ensure appropriate use or health improvement. The taste may be unacceptable so that traditional, but polluted, drinking water sources are preferred. House cleaning may be afforded higher priority than hand washing. Without prolonged and sustained health education there may be no changes in behaviour of the kind required to improve health. The "software" of human education and behaviour is often more important than the engineering "hardware".

A study in Bangladesh concluded that water supply and sanitation hardware did not, of itself, reduce diarrhea (Henry, et al., 1990). However, a study in Indonesia concluded that a piped water supply did significantly reduce the prevalence of conjunctivitis, skin and diarrhea disease (Wasito, et al., 1989).

A recent study investigated the relationship between diarrhea and various risk factors in the Linggi river basin, Malaysia (Lonergan & Vansickle, 1991). Water quality in the study area was constrained: the town sewage outfall was upstream of the town water supply intake; there was a lack of waste treatment by rubber processing plants and other industries; not all communities had access to piped water. The statistical significance of the results are indicated in the following table.
Risk factors in self-reporting diarrhea, Malaysia (Lonergan, et al., 1991)

<table>
<thead>
<tr>
<th>Significance</th>
<th>Risk factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>High (p&lt;0.001)</td>
<td>Race, frequency of boiling water, type of toilet facility, sanitary water source, clean kitchen, clean children</td>
</tr>
<tr>
<td>Moderate (p&lt;0.01)</td>
<td>Treated water, drinking water source, yard free of garbage</td>
</tr>
<tr>
<td>Slight (p&lt;0.05)</td>
<td>Sink in house, sink in kitchen</td>
</tr>
<tr>
<td>Not significant (p&gt;0.05)</td>
<td>Crowding, village, town or estate, child carer, breast feeding, frequency of water shortage, indiscriminate defecation, flooding, children play in dirt</td>
</tr>
</tbody>
</table>

The study concluded that while water supply and treatment were both important determinants of diarrhea, other variables acted to minimise these determinants. Some of these variables were associated with location and others depended on human behaviour and education, as follows:

(i) **Community vulnerability.** The community consisted of several distinct cultural groups including Chinese, Indian, Malay and Orang Asli. Incidence rates were much higher in the Indian and Orang Asli communities. Behaviour varied between communities such as boiling of polluted water and cleaning children and kitchens.

(ii) **Environmental factors.** The most vulnerable communities did not have access to unpolluted water and the design of their houses did not include a kitchen sink or a good toilet.

### C. Drainage

Domestic water supplies are often installed before attention is given to providing adequate means for sullage water disposal. Single buckets from distant stand pipes can be disposed to top soil. As water supply increases, specific methods of disposal must be planned to prevent surface pooling and contamination with sewage. Householders may then dig shallow soakpits or simply divert waste water into the street. In areas with a high water table the accumulations of waste water provide excellent breeding sites for mosquitoes that may transmit filariasis.
are frequently blocked by solid refuse. Pooling of standpipe surrounds leads to contamination of shallow groundwater by water re-entry.

Rainwater drains in tropical areas must be large to hold storm flows. They should be kept separate from either grey water or fouled sewage. Inadequate rain water drainage in residential areas creates surface pooling. Drains should connect to culverts fitted with steel entry grills.

D. Sanitation Projects

1. Fecal-Oral Infection

Fecal-oral infections are those caused by pathogens in excreta reaching the mouth through food, water, hands, or air. The associated diseases reduce human productivity and kill children and the infirm. They range from a mild gastro-enteritis to cholera and typhoid. The associated diseases are the major causes of morbidity and hospital admission in developing countries. Women and children often benefit more than men by reductions in diarrhea mortality and morbidity associated with improved water supply and excreta disposal. Soil contaminated by human excreta can result in worm infestations, such as hookworm. Symptoms include anemia and blood loss.

While fecal matter decays rapidly, the pathogens which it contains survive longer periods and even multiply. Modern sewage disposal systems usually fail to kill pathogens sufficiently. Viable pathogens remain in sludge and final effluent unless a disinfecting tertiary treatment is included. Waste stabilization ponds are the only waterborne sewage disposal system which approaches total pathogen destruction.

Water closets and bucket latrines do not dispose of waste, they merely store it for disposal elsewhere.

Underground disposal via pit latrine or soakaway uses the earth as a treatment process. The earth is an excellent processor of excreta. Pathogens are contained within 10m and chemical decomposition is complete within 20m. The capacity of the earth can be overwhelmed by excessive loading and high human densities. Shallow wells may become contaminated by nitrates.
Effective sewage systems are rare or absent in many urban centres, serving only the rich, the commercial centres and government offices (Hardoy, et al., 1991). Outbreaks of diarrhea are often seasonal and associated with rainfall or high temperature.

Family latrines are more effective than communal latrines because of maintenance and cleanliness problems. However, the cost of a septic tank falls rapidly when it serves 10-20 households (Sinnatamby, 1990). Poor siting, design and maintenance of septic tanks reduce retention times, releasing pathogen rich effluent to contaminate groundwater.

Sanitation projects can have a large impact on soil helminths and tapeworms. Improved personal hygiene can have a large impact on fecal-oral infections (Cairncross, et al., 1983). Washing facilities should be included. Septic tanks should be well sealed to prevent mosquito and fly breeding. An efficient ground irrigation disposal system is essential.

Example  A village public latrine was used by only 10% of a population of 2000, despite its convenience and good quality (Potts, pers. comm.).

Public latrines require continuous servicing and must have a more durable construction. They may serve only the clan of the land on which they are sited.

Construction of pit latrines can often encourage the breeding of mosquitoes that transmit filariasis. Simple methods of prevention are available. The problem is particularly acute where there is a high water table.

Example  Polystyrene balls poured on wet pit latrines form an effective barrier against mosquito breeding. The reduction in infectious bites per person can be greater than 99.7% (Maxwell, et al., 1990).
Appendix 11

E. Checklist

☐ Does the proposed water supply project contain an ongoing and appropriate health education component?
☐ Will maintenance of the water pump be under the control of the major users?
☐ Will domestic water storage encourage safe handling and discourage vector breeding?
☐ If wastewater is reused for agriculture, will it be suitably treated to reduce pathogens to an acceptable level?
☐ Will the design, construction, operation and maintenance of latrines prevent insect breeding, reduce helminth and enteric infection and encourage latrine use?
☐ Has mosquito control been considered by screening vent pipes, sealing septic tanks and soakaways and adding polystyrene balls to wet latrines?

F. References


APPENDIX 12 MINING

See also Changes in Land Use, Labour Mobility and Occupational Health Hazards of Industry (Appendixes 5 and 6).

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A. Communicable Disease

Opencast mineworks have often been responsible for increased malaria transmission, during the different project phases from land clearing to operation. Migrant labour may be employed from non-immune areas and may spread the disease on returning home. Mineral wealth is often located in remote areas, such as forests, where labourers may be exposed to more dangerous forest mosquitoes. Alternatively, partial clearing of forest may encourage breeding of vectors associated with more open habitats.

Example

In India, the mining of minerals and coal and the production of oil have been notoriously affected by malaria. In 1933 malaria brought iron and magnesium mines to a standstill in Orissa (Service, pers. comm.).

Mining often requires large quantities of water. Dams and canals are created to pump water in or out of the mine workings. Dumping of tailings creates artificial lakes and marshes and abandoned workings become flooded (Polderman, et al., 1985; van Ee & Polderman, 1984). These water bodies may support vector breeding.
B. Non-Communicable Disease

The air-borne particulate matter associated with mining leads to irreversible lung damage and respiratory disease.

The health impacts of deep-rock mining by migrant labour in Southern Africa has been well documented. Chronic lung disease is common and this often reacti- vates latent tuberculosis and increases susceptibility to infectious pneumonias that are exported to the labour reserve (Zwi, et al., 1988); (Phimister, 1976). Such occupational diseases are often not recorded or recognised in regions where compensation payments would be compulsory.

Communities living near mines frequently suffer from chronic exposure to heavy metals such as lead (Chenard, et al., 1987), cadmium (Neuberger, et al., 1990), arsenic (Tsuda, et al., 1990), copper and uranium (Egboka, et al., 1989). The waste water discharge and groundwater associated with mineworks is often heavily contaminated with soluble metal salts. Metal compounds contaminate waste tips and surface soils. Symptoms of intoxication include behavioral changes, nausea and headache, reproductive failure (Anonymous, 1977), fetal damage and various cancers. Women are more susceptible than men to the toxic effects of lead (Rom, 1976).

The incidence of lung cancer is increased by underground mining. The main factor is believed to be exposure to radon, a radioactive gas (Nemery, 1990).
Example

Children in a Canadian mining community had significantly elevated blood lead levels (Chenard, et al., 1987).

Residents of a USA mining community were exposed to lead and cadmium. The prevalence of kidney and heart diseases and skin cancer was significantly elevated (Neuberger, et al., 1990).

Former Japanese mine workers suffering from chronic arsenic poisoning had a significantly elevated cancer rate (Tsuda, et al., 1990).

Pollution from Ok Tedi mine, Papua New Guinea, has threatened rivers, food crops and fish used by 40,000 people. In 1988, suspended sediments and heavy metals were said to have exceeded US standards by 10,000 per cent (Hyndeman, 1988).

C. Traumatic Injury

Opencast mining requires the use of very heavy vehicles and the transport of minerals and soil over long distances. The combination of heavy and light vehicles with pedestrians on roads may lead to a high risk of accidents.

The high levels of traumatic injury among mineworkers is sometimes associated with an absence of labour organisations capable of negotiating for improved safety. In many countries there are women mineworkers who may face special hazards while being paid less (Bhatt, et al., 1988).

Quarry and deep mine workers suffer problems of heat stroke. Eye injuries result from alloy and stone chips.
Example

In construction of the Bougainville Copper mine in Papua New Guinea, a peak labour force of 4,000 expatriates and 6,000 Papua New Guineans was involved. 16 miles of mountain road, two small towns and a port were required. 40 million tons of waste rock were removed before mining began. Road accidents were the most important cause of deaths among the workforce (Wyatt, pers. comm.).

D. References


APPENDIX 13 TOURISM

Tourism is a major source of hard currency for many countries. Tourism creates a contact point between two diverse groups of vulnerable people: the tourist and the local community. The health of tourists is at risk due to their own behaviour (eg: sexual promiscuity, consumption of unhygienically prepared foods) and endemic health hazards (eg: diarrhea and chloroquine resistant malaria).

The health education of tourists is frequently inadequate. A recent review noted that less than a third of travel brochures refer to health hazards (Behrens, 1990). Only 10% of passengers are advised of malaria risks by their travel agent; less than 50% attending a pre-travel health clinic were informed about malaria transmission; about 25% of tourists used malaria chemoprophylaxis effectively. Less than 50% of passengers in a survey were aware of the high HIV prevalence in the country of their destination.

Example

Thailand earns over $1 billion p.a. from tourism, spends $170 million on tourist promotion, and has a thriving sex industry. By 1987 some 3% of male sex workers were HIV positive. More recently there has been a rapid increase (The Panos Institute, 1988).

A survey in Sri Lanka indicated that 10% of tourists had local sexual contact (The Panos Institute, 1988).

Regional authorities recognise that endemic health hazards may threaten the entire tourist industry. For this reason they may seek to deny that those hazards exist.

Travellers’ diarrhea affects 30-50% of international travellers to developing countries of whom 30% may be confined to bed. Drug prophylaxis and dietary avoidance is frequently ineffective.

Malaria prophylaxis for the tourist depends on well known drugs such as chloroquine, maloprim and paludrine (proguanil). Unfortunately, drug resistance is spreading rapidly throughout the world so that the
recommended prophylactic regime becomes ineffective. One response is to change to newer drugs such as mefloquine. However, in South East Asia almost all available drugs are now ineffective. In a survey of general practitioners less than 24% were fully aware of the distribution of chloroquine resistant malaria (Behrens, 1990).

The development of centrally air-conditioned hotels and office buildings contributes to an increase in Legionnaire’s disease, a serious form of pneumonia. The micro-organism grows in the water cooling towers and is distributed in water droplets.

The local community is at risk of acquiring exotic infections from tourists (e.g. HIV infection). Disruption of the local environment and economy threatens food security. Tourism introduces a demand for basic foods that raises the price in local markets and makes those foods unavailable to local consumers. Development of coastal wetlands for tourism changes the flow of nutrients and reduces the fish stocks on which local fishing communities depend. On the other hand, the local community benefits from new roads and the opportunity of employment.

Tourism can also undermine the culture of remote communities, introducing the diseases of affluence.

Example: In Micronesia many young adult males “drink to get drunk”. The availability of alcohol is encouraged and there is increasing promotion by importers and distributors aimed at the young and at women. Tourism is cited as one risk factor and traffic accidents as one consequence (WHO, 1989).

References


<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>abscess</td>
<td>A cavity containing pus and surrounded by inflamed tissue.</td>
</tr>
<tr>
<td>Aedes</td>
<td>Mosquitoes that are vectors of some parasites other than malaria.</td>
</tr>
<tr>
<td>aflatoxicosis</td>
<td>A diseased condition caused by the presence of aflatoxins in the body.</td>
</tr>
<tr>
<td>aflatoxin</td>
<td>A class of mycotoxins produced by a mould that grows on damp food.</td>
</tr>
<tr>
<td>agro-chemicals</td>
<td>Chemicals used in the agricultural industry such as fertilizer, pesticides and weed killers.</td>
</tr>
<tr>
<td>AIDS</td>
<td>Auto Immune Deficiency Syndrome caused by infection with the human immunodeficiency virus.</td>
</tr>
<tr>
<td>allergen</td>
<td>Any substance that induces an allergic reaction.</td>
</tr>
<tr>
<td>anemia</td>
<td>A condition characterized by a low haemoglobin level and a lack of red blood cells.</td>
</tr>
<tr>
<td>analysis</td>
<td>An examination in order to understand. See assessment.</td>
</tr>
<tr>
<td>antenatal</td>
<td>A time period between conception and birth. During this time treatment and advice is provided to pregnant women.</td>
</tr>
<tr>
<td>appraisal</td>
<td>A critical examination of an identification report, which selects and ranks the various solutions from points of relevance, technical, financial and institutional feasibility and socio-economic profitability and precedes the approval by the authorities of the proposed action.</td>
</tr>
<tr>
<td>aquatic</td>
<td>Living, growing or taking place in or on water.</td>
</tr>
<tr>
<td>arbovirus</td>
<td>An arthropod borne virus.</td>
</tr>
<tr>
<td>arthritis</td>
<td>A condition characterized by painful and stiff joints that ultimately damages and deforms the joints involved producing considerable morbidity and disability.</td>
</tr>
<tr>
<td>arthropod</td>
<td>An animal group including insects, ticks and mites.</td>
</tr>
<tr>
<td>asbestosis</td>
<td>A disease in which the lung tissue thickens in response to irritation by inhaled asbestos fibres and consequently obstructs respiration.</td>
</tr>
<tr>
<td>Ascaris</td>
<td>A parasitic worm that infests the small and large intestines of humans and animals producing occasional symptoms. It is also called a roundworm.</td>
</tr>
<tr>
<td>assessment</td>
<td>Examination in order to decide. See analysis.</td>
</tr>
<tr>
<td>axils</td>
<td>The angle between the leaf and the stem. In some plants such as bromeliads water collection can provide breeding places for mosquitoes.</td>
</tr>
<tr>
<td>bacteria</td>
<td>A class of microscopic unicellular organisms that cause many diseases.</td>
</tr>
<tr>
<td>beedi</td>
<td>An indigenous Indian cigarette.</td>
</tr>
<tr>
<td>benefit-cost</td>
<td>A term that represents the relationship between the benefits accrued for the cost incurred.</td>
</tr>
<tr>
<td>benthic</td>
<td>Adjective of beethes.</td>
</tr>
<tr>
<td>beethes</td>
<td>Flora and fauna on the bottom of a water body.</td>
</tr>
<tr>
<td>berm</td>
<td>An earthen bank raised above the ground.</td>
</tr>
<tr>
<td>bilharzia</td>
<td>See schistosomiasis.</td>
</tr>
<tr>
<td>biofuel</td>
<td>A biological, renewable source of energy.</td>
</tr>
<tr>
<td>biotopes</td>
<td>The smallest geographical unit of the biosphere or of a habitat that can be delimited by convenient boundaries and is characterised by its flora and fauna.</td>
</tr>
<tr>
<td>blue-baby syndrome</td>
<td>A condition, suffered by babies, of insufficient oxygen in the blood. The condition can be caused by nitrite ingestion.</td>
</tr>
<tr>
<td>bromeliads</td>
<td>The family of plants to which the pineapple belongs. They are associated with breeding sites for mosquitoes.</td>
</tr>
</tbody>
</table>

1. The definitions presented in this glossary are not official definitions. They have been formulated with a view to explaining technical terms to a non-technical readership. Some of the definitions have been obtained from the OECD Methods and Procedures in Aid Evaluation handbook.
bronchitis: A disease in which the lining of the bronchial tubes of the lungs are inflamed. It may be caused by bacteria, viruses, chemicals and other substances such as asbestos and dusts.

brucellosis: A bacterial infection of animals causing abortion. It can be transmitted to man resulting in recurrent or chronic fever. Also called undulant fever.

byssinosis: A lung disease of cotton workers caused by an allergic reaction to dust or fungi in inhaled cotton, flax and hemp fibers.

carcinogenic: A substance that induces the development of cancer.

cassava: Tapioca; an edible root; it contains toxic cyanide compounds in its skin and outer layers that need to be leached out during the cooking process.

Chagas: A disease in South America affecting the heart, liver, spleen and colon due to infection with the parasite Trypanosoma.

checklist: A list for verification purposes, a comprehensive list; an inventory.

chemoprophylaxis: The use of antibiotics and chemicals to prevent the occurrence or spread of a disease in man.

chlorination: A treatment process in which chlorine is used. For example, (1) to sterilise water or (2) to extract gold from ore.

chloroquine: A drug used in the prophylaxis and treatment of malaria. There is increasing resistance in the malaria parasite to chloroquine.

cholera: A highly infectious disease caused by Vibrio cholerae characterised by vomiting and rice water stools leading to rapid dehydration and death. It is spread by the feco-oral route and contamination of water and food.

chronic: Of a disease or disorder; developing slowly and persisting for a long time.

coir: The strong fibre of coconut husks.

communicable disease: Diseases that are transmitted from a person or animal to another via a host of agents such as insects, foods and contaminated materials.

congenital: Dating from birth. Refers to a disease or deformity caused by defective or inoperative genes.

conjunctivitis: An inflammation of the thin transparent lining of the eye (the conjunctiva). It is caused by viruses, bacteria, chemical substances or degenerative changes.

consumption: Pulmonary (of the lung) tuberculosis leading to the destruction of the lung and wasting away of the body.

containment: An act or policy of preventing the spread of a communicable disease.

coverage: The percentage of the susceptible population that has been immunised against a communicable disease.

cross-cutting issues: Issues of concern to more than one sector.

cross-resistance: The development of resistance to different antibiotics, drugs or pesticides of the same or related class by microorganisms or vectors.

Cryptosporidium: A microscopic organism normally found in the gut of animals. It is capable of producing diarrhea in humans particularly in immune-suppressed persons.

culvert: An arched channel beneath a road or railway to carry water.

demographic: Related to or pertaining to the study of populations; information about the composition and characteristics of a population.

dengue: An acute tropical fever caused by a virus, occasionally fatal; also known as break-bone fever. The vector is the Aedes mosquito.

dermatitis: An inflammation of the skin usually because of infection or irritation by chemical substances that come in contact with the skin.

diarrhea: Persistent purging or looseness of bowels commonly due to infection by micro-organisms such as Salmonella.

drawdown: The magnitude of the change in water surface level in a well, reservoir or natural body of water resulting from the withdrawal of water.
dysentery  Inflammation of the large intestine associated with the frequent passage of bloody stools caused by *Entamoeba histolytica* and *Shigella* species.

ecology  The study of relationship between communities of organisms and their environment.

effluent  Liquid industrial and agricultural waste; outflowing sewage during purification.

encephalitis  Inflammation of the brain tissue.

endemic  Of a disease or microorganism: indigenous to a geographic area or population.

eнтерic  Pertaining to the intestines; enteric fever or typhoid fever is an infectious disease caused by *Salmonella typhii* characterised by fever, rash, enlarged spleen and ulcers in the intestines.

epidemic  The occurrence of a disease or illness that attacks great numbers of people in one place at one time clearly in excess of normal expectancy and spreads from place to place.

epidemiology  The study of the geography, frequency, environmental and behavioural causes and transmission of disease.

epiphytic  A plant or animal growing or living on another plant or animal without being parasitic.

evaluation  An examination as systematic and objective as possible of an on-going or completed project or programme, its design, implementation and results with the aim of determining its efficiency, effectiveness, impact, sustainability and relevance of the objectives with the purpose to guide decision-makers.

ex-post  Evaluation of an intervention after it has been completed with the aim to determine how well the aid has served its purposes and to draw conclusions for similar interventions in the future.

excreta  Refers to feces and urine.

feco-oral  Related to a route of transmission of pathogens that involves food, water or objects contaminated by fecal material entering the mouth.

fallout  A deposit of dust from an explosion or industrial plant.

feasibility  A measure to prove that the technical options are sustainable and are also the best in that situation.

fertility  The ability to bear or reproduce.

filariasis  A disease due to the presence of filarial worms in the blood and lymph nodes. The vector is a mosquito.

focus/foci  Point(s) or region(s) of greatest activity of a disease and/or its vector.

food security  Access to food for all people at all times, both physically and economically.

foraging  The act of going about to obtain fodder for horses and cattle.

fuelwood  Wood collected for use as fuel.

fungi  Plants without chlorophyll which include mushrooms, and moulds.

fungicide  A chemical substance that kills fungi.

gastro-enteritis  Inflammation of the lining of the stomach and intestines producing vomiting and diarrhea caused by infection with micro-organisms or toxins.

gastrohelminths  Parasitic worms with part of their life cycle occurring in or on the soil.

grass-pea  A type of a legume, also called the chickling pea; contains a chemical substance that if consumed in large quantities damages the nerves in the spinal cord causing paralysis of the lower limbs producing a condition called lathyrism.

groundwater  Water that occurs naturally beneath the ground surface and may include the fraction of the precipitation which infiltrates the land surface.

habitat  The normal abode or locality of an animal or plant; the physical environment of a community; the place where a person or thing can usually be found.

haematuria  The presence of blood in the urine.

haemoglobin  The red oxygen-carrying pigment present in the red blood cell.
harbourage: A place of shelter and refuge; it may be natural or artificial.

hazard: Anything that jeopardizes safety or health.

health hazard: A potential for causing harm to people.

health impact (of a development project): A change in the frequency of some health indicators among the vulnerable community which is reasonably attributable to the project. The likelihood that a health hazard will cause harm to a human community. Measure of probability that a hazard will cause harm. As there are great uncertainties, only a simple ranking procedure can be used.

health risk management: Actions intended to reduce health risk.

helminth: A worm.

hexachlorohexane: An insecticide of the organochloride (organic chemicals containing chloride) group.

hinterland: A region lying inland from a port or an urban centre, or a centre of affluence; terrain on the back of a folded mountain chain.

HIV: Human Immunodeficiency Virus that causes the Auto Immune Deficiency Syndrome (AIDS).

hookworm: A parasitic worm that causes anemia.

host: An organism, on or in which a parasite lives and feeds.

hyperkeratosis: Thickening of the superficial layer of the skin.

HYV: High Yielding Varieties, of agricultural crops.

immunization: A process that induces or increases the capacity of a person or animal to resist infection.

immuno-suppression: A decrease in the capacity of a person or animal to resist infection.

impact (of a development project): A term indicating whether the project has had an effect on its surroundings in terms of technical, economic, socio-cultural, health, institutional and environmental factors.

incidence: The number of cases of a specified disease diagnosed or reported during a defined period of time, divided by the number of persons in the population in which they occurred.

infectious: The ability of a disease organism to spread from one person to another.

infertility: The inability to bear or produce offspring.

JE: Japanese Encephalitis, a mosquito borne arbovirus which can cause severe or fatal disease.

jute: A plant fibre used for making sacks and mats.

kwashiorkor: A nutritional disease of weaning children in the tropics due to a relative deficiency of protein probably as a result of altered protein metabolism.

lathyrism: A disease with stiffness and paralysis of the legs among eaters of the grass-pea.

leaching: The removal of readily soluble components, such as chlorides, sulphates and carbonates, from soil by percolating water.

leishmaniasis: A disease caused by parasitic protozoa of the genus Leishmania that is transmitted from person to person by sandflies; also known as Kala-azar and Oriental sore.

leptospirosis: A disease caused by bacteria of the species Leptospira. It is transmitted to people by contact with animals, moist soil, recreational, accidental or occupational immersion in water or vegetation contaminated with urine of infected animals such as pets and rodents.

malaprim: A drug used in malaria prophylaxis.

malaria: A mosquito-borne disease caused by Plasmodium parasites.

malnutrition: Undernourishment, a deficiency condition in which one or more necessary nutrients are unavailable in sufficient amounts for normal growth and maintenance.

marginalization: The process of pushing a vulnerable population group out of the socio-economic mainstream.

measles: An infectious viral disease of children causing fever and a rash.
mefloquine A drug used in the treatment of malaria, particularly chloroquine resistant malaria.

micronutrients Nutrients necessary for the normal growth and maintenance of the body but required in very small amounts, such as vitamins, iron and zinc.

migration Permanent movement of a population from one habitat or location to another.

monitoring A management function which uses a methodical collection of data to determine whether the material and financial resources are sufficient, whether the people in charge have the necessary technical and personal qualifications; whether activities conform to work plans, and whether the work plan has been achieved and has produced the original objectives. See surveillance.

Environmental Monitoring: observation of effects of development projects on environmental resources and values, including sampling and analysis, during construction and operation.

mosoculture The cultivation or culture of a single crop or species to the exclusion of others; as in replanting deforested areas with only one or few species.

morbidity The condition of illness or abnormality; the rate at which an illness occurs in a particular area or population.

mortality The condition of being subject to death; the death rate, the frequency or number of deaths in any specific region, age group, disease or other classification.

muco-cutaneous Of or pertaining to the mucus membrane and skin.

mycotoxins Toxins produced by fungi that are harmful.

neurotoxin A toxin that has an affinity for the nervous system.

niacin A member of the Vitamin B group of micronutrients.

nomadism A sustainable lifestyle that requires frequent travelling from place to place usually within a well-defined geographical territory.

non-communicable Cannot be spread from one person to another.

non-immune Susceptible to a disease.

occupational disease A disease common among workers engaged in a particular occupation brought about by the conditions of that occupation.

onchocerciasis A disease caused by the parasitic worm Onchocerca volvulus that is transmitted by black flies; also called river blindness.

opencast A mining process by which the material is excavated from an extensive area of the earth's surface.

outbreak A sudden occurrence of, or increase in, cases of a disease in a population in an area or locality.

paludrine A drug used in malaria prophylaxis.

parasite An organism that lives on or in another organism termed the host, and draws nourishment from it.

parathion An insecticide from the organophosphate group of insecticides.

pastoralism Keeping herds of cattle, goats, sheep or similar animals.

pathogen An organism that causes disease. Most pathogens are microscopic in size.

periurban Localities bordering a city or other urban area.

plague A disease caused by infection with the bacillus Yersina pestis that is usually transmitted from rodents to people by fleas.

plume A narrow column of smoke or noxious gases.

pneumoconiosis A disease of the lung caused by long-term inhalation of dust, usually mineral dusts of occupational or environmental origin.

pneumonia An inflammation of the lung caused by pathogenic organisms such as bacteria, viruses and chemicals.

poliomyelitis A communicable disease caused by one of the three polio viruses that may result in paralysis.

potable water Water that is palatable and safe for human consumption; in which any toxic substances, pathogenic organisms and factors have been reduced to safe or acceptable levels.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>prevalence</td>
<td>The number of people ill because of a particular disease at a particular time in a given population. Often expressed as a rate.</td>
</tr>
<tr>
<td>prophylaxis</td>
<td>The methods used to prevent the occurrence of, or progression to disease.</td>
</tr>
<tr>
<td>protection agency</td>
<td>Government agencies responsible for protecting the health and safety of the community and the environment.</td>
</tr>
<tr>
<td>protein-energy</td>
<td>Energy derived from the metabolism of proteins in the human body.</td>
</tr>
<tr>
<td>psittacosis</td>
<td>A type of pneumonia that is transmitted to humans from birds.</td>
</tr>
<tr>
<td>pyrethrum</td>
<td>A natural insecticide extracted from chrysanthemum flowers.</td>
</tr>
<tr>
<td>pyrethroid</td>
<td>A group of powerful synthetic insecticides.</td>
</tr>
<tr>
<td>recrudescence</td>
<td>The recurrence of a disease because of reinfection rather than a reactivation of existing microorganisms.</td>
</tr>
<tr>
<td>resistance</td>
<td>The development of capacity by an organism to withstand the killing effect of a chemical or drug.</td>
</tr>
<tr>
<td>respiratory</td>
<td>Pertaining to the lungs and the breathing apparatus of the body.</td>
</tr>
<tr>
<td>rodenticide</td>
<td>A chemical used to kill rodents.</td>
</tr>
<tr>
<td>runoff</td>
<td>Precipitation which flows over the surface of the land as opposed to that which penetrates beneath the surface.</td>
</tr>
<tr>
<td>STD</td>
<td>Sexually Transmitted Disease.</td>
</tr>
<tr>
<td>Salmonella</td>
<td>Bacteria that cause typhoid, diarrhoea and other diseases. Usually associated with poultry and animal husbandry and transmitted from animal to humans and from humans to humans by the feco-oral route and contamination of food and drinking water.</td>
</tr>
<tr>
<td>schistosomiasis</td>
<td>A disease, caused by infestation of the human body by the worms of Schistosoma, characterised by passing of blood in the urine or stool. Also called bilharzia.</td>
</tr>
<tr>
<td>scope</td>
<td>A field of activity.</td>
</tr>
<tr>
<td>scoping</td>
<td>A process of defining which communities, hazards, geographical areas and project phases to include in an impact assessment.</td>
</tr>
<tr>
<td>screening</td>
<td>A process of sorting project proposals as part of an initial environmental examination to ascertain the need for health impact assessment.</td>
</tr>
<tr>
<td>seasonality</td>
<td>Showing periodicity related to seasons.</td>
</tr>
<tr>
<td>sedentarization</td>
<td>Settlement of nomads in permanent locations.</td>
</tr>
<tr>
<td>septic fringe</td>
<td>Unsanitary environment of slums and squatters.</td>
</tr>
<tr>
<td>sewage</td>
<td>Human excreta and waste water flushed along a sewer pipe.</td>
</tr>
<tr>
<td>silicosis</td>
<td>A chronic lung disease caused by long-term inhalation of silica dust.</td>
</tr>
<tr>
<td>smallholder</td>
<td>A farmer who owns a small area of land for subsistence farming.</td>
</tr>
<tr>
<td>soakpits</td>
<td>Pits to promote seepage of effluent into the ground.</td>
</tr>
<tr>
<td>standpipe</td>
<td>A tap on the end of a free standing water pipe.</td>
</tr>
<tr>
<td>subsistence</td>
<td>Providing the bare necessities of living.</td>
</tr>
<tr>
<td>sullage</td>
<td>Domestic dirty water not containing excreta; also called grey water.</td>
</tr>
<tr>
<td>surveillance</td>
<td>A continuing scrutiny of all aspects of the occurrence and spread of a disease that are pertinent to effective control. Alternatively, a special reporting system for a particular health problem for a limited time period.</td>
</tr>
<tr>
<td>susceptibility</td>
<td>The incapacity to resist contracting a disease when exposed to the agent causing that disease.</td>
</tr>
<tr>
<td>sustainability</td>
<td>The extent to which the objectives of an aid activity will continue after the project assistance is over; the extent to which the groups affected by the aid want to take charge themselves to continue accomplishing its objectives.</td>
</tr>
<tr>
<td>syndrome</td>
<td>A characteristic pattern of symptoms and signs that describe a disease entity.</td>
</tr>
<tr>
<td>tailings</td>
<td>Soil and other debris washed out of a mine works.</td>
</tr>
<tr>
<td>tapeworms</td>
<td>Parasitic worms that infect humans and animals.</td>
</tr>
<tr>
<td>transmission</td>
<td>Any route by which a human being is exposed to an infectious agent.</td>
</tr>
<tr>
<td>trichinosis</td>
<td>A disease caused by the migration through the skin of larvae of a worm called <em>Trichinella spiralis</em>.</td>
</tr>
<tr>
<td>Trichuris</td>
<td>A parasitic worm that infests the intestines of humans.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<td>-----------------</td>
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<tr>
<td>trypanosomiasis</td>
<td>A disease of animals and humans caused by a <em>Trypanosoma</em> parasite; called sleeping sickness in Africa and Chagas' disease in South America.</td>
</tr>
<tr>
<td>tsetse</td>
<td>A blood-sucking fly that is the vector of trypanosomiasis in Africa.</td>
</tr>
<tr>
<td>tuberculosis</td>
<td>A chronic and disabling disease of the lungs, and less frequently other parts of the body, which is fatal if not treated.</td>
</tr>
<tr>
<td>typhoid</td>
<td>An infectious disease in humans caused by <em>Salmonella typhi</em> bacteria. It is transmitted by the feco-oral route and contamination of drinking water and food.</td>
</tr>
<tr>
<td>typhus</td>
<td>An infectious disease spread from person to person by the body louse, fleas, mites or ticks.</td>
</tr>
<tr>
<td>vector</td>
<td>An animal - often an insect - transmitting an infection from person to person or from infected animals.</td>
</tr>
<tr>
<td>vulnerability</td>
<td>The liability to be injured or damaged or hurt.</td>
</tr>
<tr>
<td>wild foods</td>
<td>Foods which are gathered, fished, or hunted, but not cultivated.</td>
</tr>
<tr>
<td>zoonosis</td>
<td>An infectious disease transmissible under natural conditions from animals to humans.</td>
</tr>
<tr>
<td>zooprophylaxis</td>
<td>The use of animals to divert vectors from humans.</td>
</tr>
</tbody>
</table>