PART A: Introduction

Water related diseases and their public health importance

Slide 1
Water may carry causative agents (pathogens) of communicable diseases of man or provide the right environment for the breeding and propagation of their vectors. Irrigation and drainage projects create great expanses of water and, provided a number of ecological conditions are met, will lead to the introduction of disease vectors in areas where they did not occur before, or to a rapid increase of their original densities. Wherever a parasite or another disease-causing organism is present, and a susceptible human population exists, environmental changes resulting from such projects may have a profound impact on the epidemiology of disease through their effect on vector bionomics. In addition, sometimes the disease agent is introduced by human migration resulting directly from project development.

Disease transmission may be particularly rapid in densely populated areas associated with irrigated lands. The adverse effects of irrigation may be related to oversights at the initial planning and construction of the system, or to its mismanagement in the operational phase. Water-related diseases may be avoided or mitigated by good engineering practice and by appropriate water management.

Water-related diseases can be classified into 4 major categories, as follows:

1: Water-borne diseases: infections spread through contaminated drinking water
2: Water-washed diseases: diseases due to the lack of proper sanitation and hygiene
3: Water-based diseases: infections transmitted through an aquatic invertebrate organism
4: Water-related vector-borne diseases: diseases transmitted by insects that depend on water for their propagation
In table 1, some of the water-related diseases which may adversely affect the human population resident of or resettled in a water resource project area are listed, these training aids deal exclusively with the third and fourth category of diseases.

Table 1: SOME WATER-RELATED DISEASES AND THEIR IMPORTANCE

<table>
<thead>
<tr>
<th>Disease group</th>
<th>Disease</th>
<th>Estimated infection rate (1'000/year)</th>
<th>Estimated morbidity (1'000/year)</th>
<th>Estimated mortality (1'000/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATER-BORNE DISEASES</td>
<td>Diarrhoeal Diseases</td>
<td>not available</td>
<td>1'000'000^1</td>
<td>5'000^1</td>
</tr>
<tr>
<td></td>
<td>Typhoid Fever</td>
<td>1'000</td>
<td>500</td>
<td>25</td>
</tr>
<tr>
<td>WATER-WASHED DISEASES</td>
<td>Ascariasis (=roundworm infection)</td>
<td>800'000-1000'000</td>
<td>1'000</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Ancylostomiasis (=hookworm infection)</td>
<td>700'000-900'000</td>
<td>1'500</td>
<td>50-60</td>
</tr>
<tr>
<td>WATER-BASED DISEASES</td>
<td>Schistosomiasis (Bilharzia)</td>
<td>200'000</td>
<td>?</td>
<td>500-1'000</td>
</tr>
<tr>
<td>WATER-RELATED VECTOR-BORNE DISEASES</td>
<td>Malaria</td>
<td>240'000</td>
<td>100'000</td>
<td>not available</td>
</tr>
<tr>
<td></td>
<td>Lymphatic filariasis</td>
<td>90'200</td>
<td>2'000-3'000</td>
<td>low</td>
</tr>
<tr>
<td></td>
<td>Onchocerciasis</td>
<td>17'800</td>
<td>340</td>
<td>20-50</td>
</tr>
<tr>
<td></td>
<td>Japanese encephalitis</td>
<td>not available</td>
<td>20-40</td>
<td>case fatality ratio between 10-30%</td>
</tr>
</tbody>
</table>

^1) Children under 5 years of age in the developing countries, excluding China

Based on WHO/HST/87.3: Global estimates relating to the health situation and trend, May 1987
This classification relates to the following conditions which characterize the situation in most developing countries and are responsible for the continued high prevalence of these diseases:

a) **Insufficient water supplies and sanitation, as well as solidwaste disposal services are important factors leading to the spread of many of the diseases.** The presence of adequate quantities of good quality water is a prerequisite for satisfactory personal and domestic hygiene. The installation of sanitation and waste disposal measures are equally essential if the standard of living is to rise for the population of an economically successful irrigation scheme. The introduction of a public health component at this stage involves only a relatively small increase in the overall cost of the project, much less than that of remedial operations which may have to be undertaken later in the absence of proper initial planning.

b) **Inadequate housing and lack of hygienic conditions:** The improvement of housing and hygienic conditions is mainly achieved through education, demonstration, and economic changes. For example, latrines have to be built, maintained and used. To reduce man-pathogen contact in the case of schistosomiasis settlements should be sited sufficiently far away to discourage the use of the irrigation canal and reservoir water as the main water supply for a community and another suitable source of water should be provided. Such siting can also serve to reduce man-vector
contact, if housing is at a distance from vector breeding places beyond the flight range of mosquitoes. Screening of houses with wiremesh gauze may give protection to the occupants.

c) Lack of good health care: For economic, managerial or technical reasons health care may be inadequate for the proper treatment of infected people and, where vaccines exist, for the organization of immunization campaigns. Attention should be given to vaccination of young children who are particularly vulnerable. Preventive medicine measures in addition to curative medicine, should be promoted whenever possible.

d) Water resource management schemes: Water resource development projects such as irrigation schemes often contribute to water related diseases, by increasing the number of vector habitats. Impoundment projects may reduce or eliminate some vector habitats, e.g. those of the blackfly vectors of onchocerciasis. Two major diseases which need to be considered are malaria and schistosomiasis. Chemical methods directed against vectors or intermediate hosts may become necessary for their control: insecticides against mosquito vectors of malaria or molluscicides against the snail intermediate hosts of schistosomiasis. Planning and designing for good water management structures may avoid problems of mosquito vectors and intermediate host snails at the same time; the development of insecticide resistance will no longer be a concern.

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**SOME REASONS FOR THE HIGH PREVALENCE OF WATER-RELATED DISEASES**

- Inadequate water supply and sanitation, and absence of solid waste disposal services
- Inadequate housing and lack of hygienic conditions
- Lack of proper health care
- Improperly designed and managed water resource development schemes

The water based and water related diseases as they will be covered in the following sections include those diseases of which the transmission can be prevented or significantly reduced by the application of environmental health engineering, seeking to modify and manipulate the environment.
Hydraulic engineering is an important component of environmental management in which relevant activities include drainage, stream canalization, lining of streams and canals, land levelling and filling to eliminate depression areas, seepage control, piped or covered canals and drains, weed control, improved water management, diking and dewatering, and strict discipline in the use of water. These measures promote the health of the community and contribute to its economic development. As a rule, no single method used by itself is sufficient to prevent occurrence of any or all of the listed diseases. An integrated control approach is needed, if permanent results are to be achieved.

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Objective of environmental management for vector control:

- reduction of the population density of target species below disease transmission threshold levels.

Relies on:

- understanding of vector ecology and population dynamics
- understanding of vector-borne disease epidemiology.
The **objective** of environmental management for vector control is the **reduction of the population density of target species below disease transmission threshold levels**. Past experience with disease vectors has shown that each species has a defined geographical distribution and occurs in large numbers only when breeding sites with optimal physical, chemical and biological conditions exist. Environmental management measures depend on a thorough understanding of **vector ecology** and population dynamics as well as an understanding of **vector-borne disease epidemiology**.
Table 2: ASSOCIATION BETWEEN VECTORS, THEIR HABITAT AND THE PRINCIPLE DISEASES THEY TRANSMIT

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- Arbovirus Diseases:
  - Dengue
  - Yellow fever
  - Japanese encephalitis

- Filariasis: Bancroftian
  - Brugian
  - Onchocerciasis

- Malaria:
  - Schistosomiasis:
    - mansoni
    - haematobium
    - japonicum

- Relation to Water:
  - Immature stages live in water
  - Lives near water
  - Entire lifecycle in water

- Preferred Habitat:
  - Rain forests
  - Riverine vegetation
  - Irrigation ditches and canals
  - Lakes and ponds
  - Wetland rice cultivation
  - Rivers and streams
  - Human settlements
  - Coastal plains
adapted from: Guidelines for forecasting the vector-borne disease implications in the development of a water resource project (preliminary draft version), VBC 186.3, WHO, Geneva
For more detailed information on vectors, the diseases they transmit and the ecological requirements of each species please refer to annex 4