Wetlands and infectious diseases

Terras alagadiças e doenças infecciosas

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Abstract *There is a historical association between wetlands and infectious disease that has led to the modification of wetlands to prevent disease. At the same time there has been the development of water resources projects that increase the risk of disease. The demand for more water development projects and the increased pressure to make natural wetlands economically beneficial creates the need for an ecological approach to wetland management and health assessment. The environmental and health interactions are many. There is a need to take into account the landscape, spatial boundaries, and cross-boundary interactions in water development projects as well as alternative methods to provide water for human needs. The research challenges that need to be addressed are discussed.*

Key words *Communicable Diseases; Ecosystem; Public Health; Health*

Resumo *Existe associação histórica entre terras alagadiças – pântanos, várzeas etc. – e doenças infecciosas, o que levou à modificação deste tipo de terreno no intuito de prevenir as doenças. Houve, ao mesmo tempo, o desenvolvimento de projetos de recursos hídricos que aumentam o risco de doenças. A demanda por mais projetos hidrológicos e a exacerbação da pressão no sentido de tornar produtivas as áreas alagadiças criam a necessidade de uma abordagem ecológica – com numerosas interfaces ambientais e sanitárias – para a gestão das terras alagadiças e a avaliação da saúde. Os projetos hidrológicos precisam levar em conta a paisagem, as fronteiras espaciais e as interações transfronteiriças, assim como métodos alternativos de abastecimento d'água para uso humano. O autor discute os desafios de pesquisa que devem ser enfrentados nesta área.*

Palavras-chave *Doenças Transmissíveis; Ecossistema; Saúde Pública; Saúde*

Introduction

There has been a long history of the association of wetlands with infectious disease. The alteration of wetlands or environmental management of wetlands for the control of disease is well documented and continues to be the main method of reducing the risk of disease. In addition, the development of water resources for a wide range of human activities such as energy and agricultural production has increased the need for mitigating the effects caused by such construction. The construction of water development projects will continue long into the future.

At present there is considerable reference to disease and water development projects (FAO, 1987; Hunter et al., 1993; Jobin, 1999). The main parasitic diseases associated with water development projects are schistosomiasis, lymphatic filariasis, onchocerciasis, and malaria. These four diseases have been given priority by the World Bank (Tiffen, 1989) because:

- they can cause death and/or severe disability;
- a large proportion of the population at risk becomes ill;
- the diseases are difficult to control once they become widespread or endemic; and
- ill health lasts a long time.

Other diseases such as Japanese encephalitis are important in more restricted geographical areas.

The increase in artificial wetlands (i.e., water resource development) and the destruction of natural wetlands to decrease disease risk are the major concerns associated with wetlands and disease today.

Water resource development

Irrigated land has doubled from 150,549 (thousand hectares) to 228,672 (thousand hectares) from 1965 to 1988, and will continue to increase. There are approximately 45,000 dams at present, and the number is increasing to meet demands. These trends will have an enormous impact on ecosystem and health. The main issue related to ecosystems and disease is competing demands. According to the World's Water 1998-1999 biennial report on freshwater resources (WCD, 1999):

- one-half the world's population lacks basic sanitation services. More than one billion people lack potable drinking water;
- nearly 250 million cases of cholera, dysentery, and other water-related diseases are reported each year;
- water-borne diseases kill between 5-10 million people a year;
- more water for a growing population means greater demand for fresh water for industry, agriculture, and urban areas; and
- more water for human and economic demands means less water available for natural ecosystems, including wetlands and forests.

Scenario: more dams and irrigation projects will be built, human diseases will increase, and the natural ecosystem will die.

The types of irrigation schemes most associated with health hazards have the following characteristics (Tiffen, 1989):

- soils present drainage problems, and drainage channels are absent or poorly maintained;
- rice or sugarcane is cultivated;
- reservoirs are built, or pits are left with standing water;
- canals are unlined or have unchecked vegetation growth; and
- there is settlement of new immigrants or resettlement of residents into more compact settlements. People without immunity may come into contact with a new disease, or they may bring a new source of infection with them. New dense resettlements can facilitate disease transmission.

There are two separate categories of wetlands that we are concerned with that challenge us to take a more ecosystemic approach to health. The first are the water development projects that increase the amount of wetlands and/or change the seasonality of the wetlands due to water regulation. The second is the modification of natural wetlands.

If we look at the ecological impact of a dam project, we note that there are several changes in the region's ecology (Figure 1). The reservoir itself increases the former river's surface area, water backs up upstream in the catchment area, and there is a potential change in the water flow and riverbed structure downstream. In addition, if water is diverted for agriculture there can be a tremendous impact on water flow into the estuary at the mouth of the river. All these factors can alter the original ecological interactions. One of the many potential impacts is a decrease in estuary viability. For example, lower water discharge can make the estuary unsuitable as a breeding area for marine fish and crustaceans, which can lower its value as a source of income.

The associated health impacts by geographical area are listed in Table 1.

When one overlays the human activities of resettlement, agriculture, displacement, migration, immigration, and circulation in and around the basin, there are not only ecological changes associated with these activities, but a

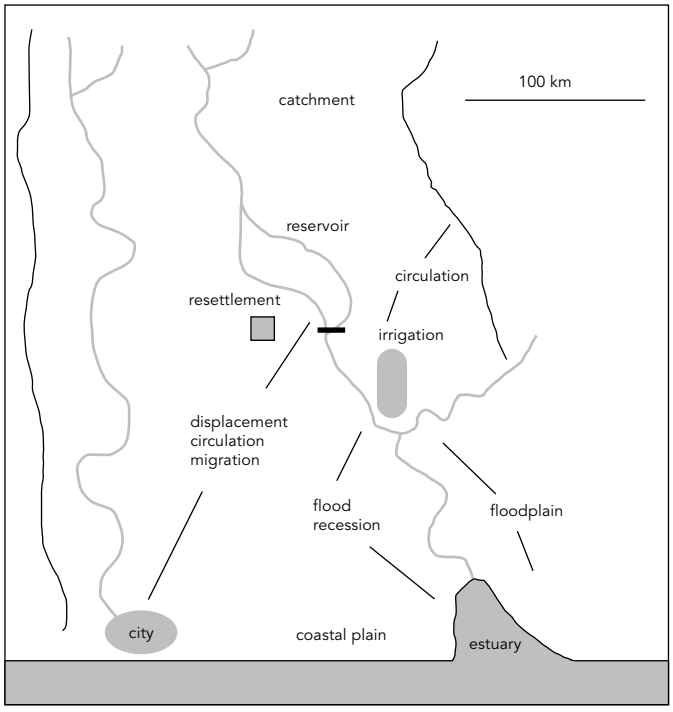
potential increase in human health problems (Table 2). These types of ecological and human health associations are applicable to any water development project.

There is great deal of literature on case studies, ecological and health impacts, and guidelines for forecasting and incorporating health safeguards into water development projects. However, what is lacking is the incorporation of health impact assessments into pre-development plans and post-development monitoring. Few environmental impact assessments have health as an important component. Few water resource development projects place a value on either the existing ecosystem or alternatives to dams such as alternative delivery systems for agriculture.

An ecological approach to the health issues takes into account the landscape, spatial boundaries, and cross-boundary interactions, both ecological and epidemiological (Figure 1). This requires a change in our approach to water development.

Figure 1

Spatial boundaries of a health assessment (WHO, 1999).



Natural wetlands

The second major wetland issue involves natural wetlands and disease. More than 700 ecologically important natural wetlands covering more than 120 million hectares have been registered in neotropical region alone. They have been classified into at least nine major types that range from mangroves to swamp forests. They are under great pressure to be economically productive. They are also areas where vectors or agents of infectious diseases are present. The protection and use of wetlands has direct and indirect effects on human health. However, our ability to quantitatively assess the health value of wetlands and modifications thereof is limited (Darnell, 1979; Turner, 1991).

In the past, wetlands have been modified to eliminate or reduce the risk of disease. This is particularly the case for malaria (Berti, 1945; Kitron & Spielman, 1989). However, recent work has shown that control of mosquito vectors can be achieved within the context of preservation and wise management of wetlands (Carlson et al., 1991; Batzer & Resh, 1992; Zimmerman & Berti, 1994). In particular, it has been shown that the use of ecological mapping techniques to define breeding sites and design control strategies can dramatically reduce the use of insecticides in wetlands and has the potential to decrease environmental modifications (Gabinaud, 1987).

The most successful infectious disease control programs have conducted basic and applied research on the biology of the vector and pathogen in order to obtain a basic understanding of the dynamics of disease transmission before implementing control. These data are the foundation for control strategy development. However, the sociological and behavior components of disease are often neglected.

Much more needs to be done to better understand the function and structure of wetlands and the biological niches of vectors and pathogens within them. One of the main challenges is to integrate wetland ecosystem research with disease ecology research. Recent attempts have been made in eco-epidemiological research (Barrera et al., 1998, 1999). Many studies only consider ecological risk factors and do not incorporate the spatial/temporal relationship of the infectious disease with wetland ecosystems. There is an urgent need for long-term studies with an ecosystem approach to wetland and disease issues. Scientists in public health, wetland ecology, and conservation need to work together to form integrated research teams. There is also an urgent need for an economic valuation of wetland resources (Turner, 1991). Our challenge is the following: *"whenever possible, we should let natural systems alone,*

Table 1

Association of various geographical components with major health impacts (modified from WHO, 1999).

	Communicable disease	Non-communicable disease	Injury	Nutrition	Psychosocial disorder
Reservoir	•	•	•	•	
Upper catchment	•				
Irrigation scheme	•	•		•	•
Flood plain	•	•	•	•	•
Estuary	•			•	
Urban slums	•			•	•
Coast				•	

Table 2

The typology of human circulation (modified from Birley, 1995).

Location	Circulation				Migration	
	Daily	Periodic	Seasonal	Long-term	Irregular	Regular
Rural/Rural	Cultivating[1]	Hunting[1]	Pastoral[1,2]	Labor[1,2]	Nomads[1,2]	Resettlement[1,3]
Rural/Urban	Commuting[1]	Trade[1,2,3]	Labor[1]	Labor[1,2,3]	Drought[1,2,3t]	Labor[1,2,3]
Urban/Rural	Cultivating[1]	Trade[1]	Labor[1]	Trading[1,2]	Refugees[1,2,3]	Retirement[1]
Urban/Urban	Commuting[1]	Trade[1,3]	Trade[1]	Relocation[3]	Refugees[3]	Retirement[3]

[1] communicable disease (e.g. vector-borne diseases, sexually transmitted diseases).
[2] malnutrition/injury.
[3] psychosocial (e.g. alcoholism, stress, depression).

that necessary intrusions be carried out with minimum disturbance, and that special care be taken to avoid disturbance of areas of critical environmental concern" (Darnell, 1979:208).

Challenges

- Develop a landscape approach to investigating wetland and disease issues.
- Eliminate political and administrative boundaries in favor of ecosystem boundaries.
- Define the ecological and health impact determinants.
- Incorporate health impact assessment into water development projects, either in parallel or incorporated into environmental impact assessment pre- and post-development.
- Develop integrated infectious disease control strategies that do not demand modification of natural wetlands.
- Conduct economic valuation of wetland resources.

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