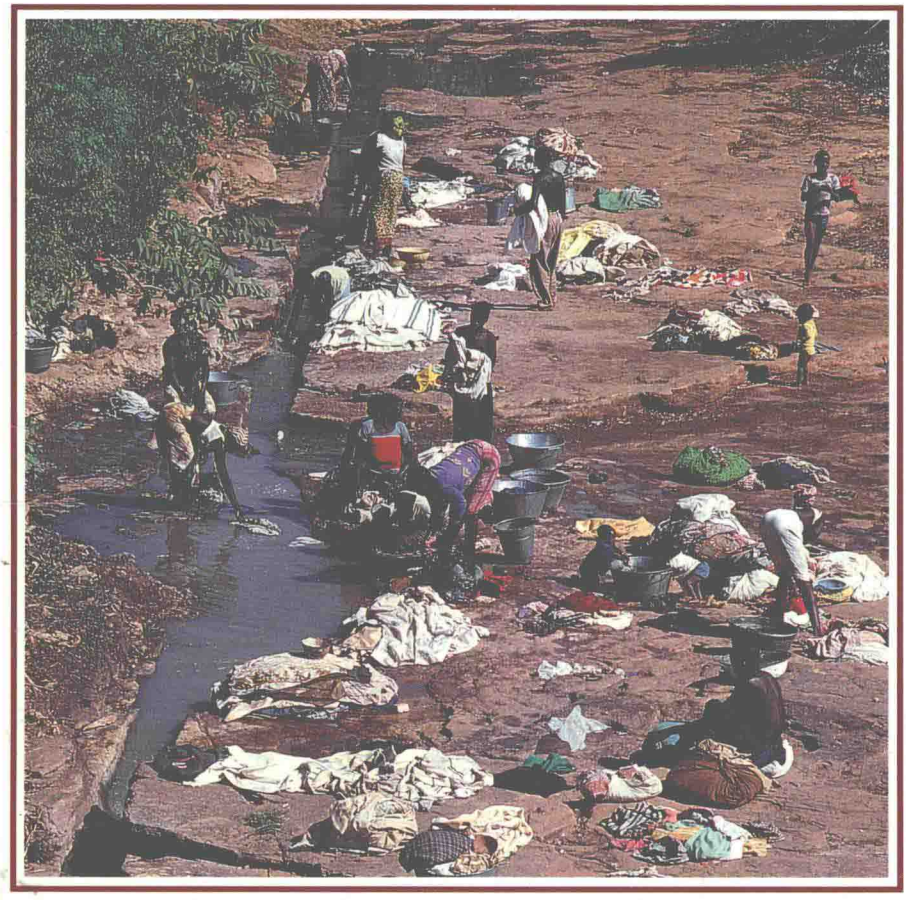
Parasitic diseases in water resources development

The need for intersectoral negotiation



J.M. Hunter • L. Rey • K.Y. Chu • E.O. Adekolu-John • K.E. Mott

World Health Organization
Geneva

Parasitic diseases in water resources development

The need for intersectoral negotiation

J. M. Hunter

Professor of Geography, Community Health Sciences and African Studies
Michigan State University
East Lansing, MI, USA

L. Rey

Department of Biology
Oswaldo Cruz Foundation
Rio de Janeiro, Brazil

K. Y. Chu

Formerly Biologist, World Health Organization

E. O. Adekolu-John

Professor of Epidemiology and Community Health
University of Ilorin
Ilorin, Kwara State, Nigeria

K. E. Mott

Chief, Schistosomiasis Control
World Health Organization
Geneva, Switzerland

World Health Organization
Geneva
1993

WHO Library Cataloguing in Publication Data

Parasitic diseases in water resources development : the need for intersectoral negotiation / J. M. Hunter. . . [et al.]

1.Disease vectors 2.Health policy 3.Parasitic diseases – prevention & control 4.Water resources development I. Hunter, J. M.

ISBN 92 4 156155 6 (NLM Classification: WC 695)

Typeset in India
Printed in England

91/9105 – Macmillans/Clays/Mosaic – 8000

Preface

One of the cornerstones of WHO's Global Strategy for Health for All by the Year 2000 is intersectoral collaboration, and various resolutions of the World Health Assembly have encouraged WHO and its Member States to promote such collaboration in order to address the health aspects of development policies.

The increased awareness of the environment, together with the feasibility of controlling parasitic diseases, provides a good opportunity to focus attention on the health impact of development. Several such diseases can be exacerbated by water development projects unless appropriate measures for prevention and control are incorporated from the beginning. The health sector therefore needs to be involved at every stage of such projects in order to ensure that socioeconomic development does not bring about a deterioration in health status.

This book reviews the documented health impact of various water resources development projects and discusses the actions that could have mitigated the adverse effects. The message derived from the analysis is that sound proposals to control parasitic diseases could and should have been included in the development dialogue. For this to occur, the health sector needs to take a much more active role in ensuring that other sectors are aware of the potential health impact of development projects.

The analysis given here is of necessity incomplete and with a bias related to the ease of availability of data. The documentation of negative effects is not intended to be a deterrent to development. Rather it is hoped that it will encourage more complete and systematic monitoring of the health effects of water resources development, and provide a guide to the risks to be considered and the input needed from the health sector.

Readers are invited to send any information, comments or suggestions related to this publication to Chief, Schistosomiasis and other Trematode Infections, Division of Control of Tropical Diseases, World Health Organization, 1211 Geneva 27, Switzerland.

Acknowledgements

Our appreciation and sincere thanks go to Mr R. Bos, Secretary of the FAO/UNEP/WHO Panel of Experts on Environmental Management; Dr R. Goodland, Chief, Department of Environment, World Bank, Washington, DC, USA; Ms Catherine Mulholland, Assistant to the Adviser on Health and Development Policies, Office of the Director-General, WHO; and Dr S. Litsios, Operational Research, Division of Control of Tropical Diseases, WHO, who provided detailed written critiques of the draft document and additional materials without which it would not have been possible to clarify the most difficult issues on contemporary development policy.

We are also grateful for the documentation and expert opinion freely given by the following WHO staff members: Dr P. F. Beales, Chief, Training, Division of Control of Tropical Diseases; Dr A. El Bindari Hammad, Adviser on Health and Development Policies; Dr P. Herath, Scientist, Operational Research, Division of Control of Tropical Diseases; Dr R. Leberre, Chief, Filariasis Control, Division of Control of Tropical Diseases; and Mr H. Dixon, Chief, Epidemiology and Statistical Methodology, Division of Epidemiological Surveillance and Health Situation and Trend Assessment.

Many of the documents prepared for the WHO Informal Meeting on the Global Strategy for the Control of Morbidity due to Schistosomiasis, held in October 1989 and supported by the Edna McConnell Clark Foundation, were useful in the preparation of this document. All the WHO Regional Advisers on Parasitic Diseases commented on and contributed to the draft manuscript.

The following people kindly supplied valuable information, mostly based on field observations:

Dr M. A. Amin, Ministry of Health, Gizan, Saudi Arabia; Professor F. Arfaa, Concord, California, USA; Dr F. S. Barbosa, Dean, National School of Public Health, Rio de Janeiro, Brazil; Dr D. J. Bradley, London School of Hygiene and Tropical Medicine, London, England; Dr C. A. Brown, Bureau of Hygiene and Tropical Disease, London, England;

Dr J. Cook, Edna McConnell Clark Foundation, New York, USA; Dr M. Delabaere, "Prince Léopold" Institute, Antwerp, Belgium; Dr A. Gani, Ministry of Health, Depok, Indonesia; Professor E. G. Garcia, School of Public Health, University of the Philippines, Manila, Philippines; Dr P. L. Gigase, Laboratory of Histopathology and Schistosomiasis, "Prince Léopold" Institute, Antwerp, Belgium; Dr S. M. El Hak, Ministry of Health, Cairo, Egypt; Dr L. Iarotski, Martsinovsky Institute of Medical Parasitology, Moscow, Russian Federation; Dr W. R. Jobin, Blue Nile Associates, Foxboro, Massachusetts, USA; Dr P. Jordan, Ware, England; Professor M. Le Bras, Department of Health and Development, University of Bordeaux II, Bordeaux, France; Professor Madya Pheng Kan Chua, Department of Parasitology, Faculty of Medicine, Kuala Lumpur, Malaysia; Dr E. A. Malek, Director, Laboratory of Schistosomiasis, Medical Center, New Orleans, USA; Professor S. P. Mao, Director, Institute of Parasitic Diseases, Chinese Academy of Preventive Medicine, Shanghai, China; Dr D. A. Muir, Geneva, Switzerland; Dr A. S. Muller, Director, Department of Tropical Hygiene, Royal Tropical Institute, Amsterdam, Netherlands; Dr M. Odei, Institute of Aquatic Biology, Achimota, Ghana; Dr J. L. Rey, Department of Epidemiology, French Institute for Cooperative Scientific Research for Development (ORSTOM), Abidjan, Côte d'Ivoire; Dr H. P. Striebel, Ciba-Geigy, Basel, Switzerland; Dr T. I. Soewarso, Ministry of Health, Jakarta, Indonesia; Dr V. R. Southgate, Experimental Taxonomy Unit, Department of Zoology, British Museum, London, England; Dr R. F. Sturrock, Department of Medical Helminthology, London School of Hygiene and Tropical Medicine, St Albans, England; Professor H. Tanaka, Public Health Laboratory of Chiba Prefecture, Chiba, Japan; Dr P. G. Waiyaki, Kenya Medical Research Institute, Nairobi, Kenya: Dr K. S. Warren, Maxwell Communications, New York, USA; Professor G. Webbe, Winches Farm, London School of Hygiene and Tropical Medicine, St Albans, England; and Dr F. Wurapa, WHO Regional Office for Africa, Brazzaville, Congo.

We are grateful to Miss J. Salm and Miss J. Mercado for typing the manuscript under pressure of tight deadlines.

Contents

1.
Introduction

The development of water resources is essential for a wide range of human activities. In particular it is needed so that demands for energy and food can be met. However, during the past ten years, certain adverse effects of water resources development have received considerable attention. The rate of population growth in developing countries continues to outstrip their capacity to meet the demands for food and basic services amid increasing poverty. The prospect of environmental degradation in the face of development was examined by the World Commission on Environment and Development (1987). The health impact of this degradation was emphasized in the report of the WHO Commission on Health and Environment, *Our planet, our health* (WHO, 1992a). This report contributed significantly to the debate on the impact of development on the environment and health at the Earth Summit, the United Nations Conference on Environment and Development, held in Rio de Janeiro in June 1992.

Development policies designed to improve the economic conditions and living standards of communities often have unintended effects on health (Cooper Weil et al., 1990). Thus, health policy is not a matter solely for the health sector, and it is now accepted that there should be health objectives in water resources development. Furthermore, the identification of vulnerable groups and their health risks is necessary so that adverse socioeconomic factors can be combated.

Awareness of the negative health effects of development, particularly in respect of parasitic diseases, has not led to consistent action either in the planning stages of projects or at the first signs of unfavourable consequences. During the 1970s, the public began to appreciate that economic development could produce adverse effects on human health, as pointed out by Hughes & Hunter (1970). Since then the epidemiological factors contributing to the introduction, spread or aggravation of parasitic diseases have become more fully understood. There have been advances in diagnosis and treatment, and options for community-based health care delivery have become available. Moreover, the connections between health, environment and development have become clearer. The inadequacy of data on the link between economic

considerations and environmental events cannot excuse a failure to reckon with the available health data. The underlying causes of poor health may be activities that seem remote from the observed effects. The focus of this book is justified by the significant amount of data available, the impact of parasitic diseases on people involved in or living near water resources projects, and the feasibility of mitigating, preventing and controlling these diseases.

It is now recognized that measures of mitigation and prevention should be a shared responsibility in the development process. Donors and entrepreneurs in developed countries can no longer claim ignorance of the potential negative health outcomes, nor can governments of developing countries justify the ecological changes inherent in water resources development on purely economic grounds. More importantly, the political will of developing countries to address these problems is now a matter of public record. The incidence and prevalence of parasitic diseases and certain other communicable diseases remain the most dramatic and reliable indicators of the negative health impacts of development in Africa, Asia and the Americas.

In earlier reviews, evidence was assembled to show the adverse disease impact caused by water resources development (Ackermann et al., 1973; Stanley & Alpers, 1975; Hunter et al., 1980, 1982). Action without consultation by different sectors was identified as the main factor engendering disregard and neglect of human health. A policy of integrated project development was offered, with carefully planned support for health maintenance in and around large reservoirs and irrigation systems.

Today, with a population doubling time of 34 years in the developing world, the need for dams and irrigation schemes is greater than ever before. In the 1970s the economic justification for constructing reservoirs began to be questioned (UNEP, 1982). The economic and nutritional justifications for expanding agriculture and irrigation remain paramount (Lipton & de Kadt, 1988), while there has been a public and political awakening to environmental problems (UNEP, 1987a, 1988, 1989, 1990). Aside from visible degradation, disease in exposed populations may be the first consequence that provokes public reaction. Despite this, adverse health effects of water resources development continue unabated (Service, 1989a,b).

Health officials in developing countries need to enter the development dialogue to place health on the national development agenda. The obvious arguments for entering the dialogue may be the impetus required to induce action at the higher levels of government. While it may appear that intersectoral dialogue in the international or multilateral arenas can be achieved, its success in practice and the impact on health are questioned by the studies documented in this book. The lack of dialogue and its inevitable outcome—lack of action—are predictable.

Those who understand health problems and, as the case in point, parasitic diseases, those who assess the results of intervention, and those who propose solutions move independently of those who decide and implement water resources development projects. Lack of foresight, the adverse consequences, and their late recognition are the fruit of this continuing lack of communication.

The global agenda on environmental issues now includes health (UNEP, 1986, 1990; WHO, 1992a; World Bank/International Monetary Fund, 1989). The international development finance community endorses environmental impact assessment through more integrated and health-conscious planning. Speedier change and more resolute commitment to health protection are needed. The present analysis is intended to promote the movement towards more integrated development activities, incorporating health protection and promotion measures along with economic advancement. Evidence concerning water-related parasitic diseases is reviewed in a broad policy context. Detailed information on other communicable diseases or health problems that may affect specific regions, such as dengue and Japanese encephalitis, may be found elsewhere. An exposition of associations between disease and environment is followed by an outline of the adverse health effects of dams and irrigation systems. The need is emphasized for continuing vigilance as water-related development proceeds on a massive scale. Small dams are presented as a special case in Chapter 4. The current status of technical measures for disease control is summarized in Chapter 5.

A policy critique (Chapter 6) is followed by proposed practical steps towards solutions. If the tools described are used, the best possible terms for health should be obtainable. Intersectoral negotiating strategies for health officials are considered in Chapter 8, and finally, the preparation of a health plan for a water resources project is outlined.

2.

Parasitic diseases and water resources development

Exacerbation of parasitic diseases

Outstanding among the parasitic diseases exacerbated by water resources development projects are lymphatic filariasis, malaria and schistosomiasis. Although the importance of lymphatic filariasis is widely recognized among health workers, the onset and increase of the disease in these situations are poorly documented. This presents a major challenge for the future monitoring of parasitic diseases in water resources development.

The present book concentrates on four parasitic diseases—malaria, schistosomiasis, lymphatic filariasis and onchocerciasis—but this should not be interpreted as indicating that they are the only ones of concern in water resources projects. There is a plethora of guidelines on potential health risks, with no analysis of cause-and-effect relationships or documentation of effective mitigation or intervention, which is of little use to planners or actors on the health scene. Water resources projects lead to the aggregation of people; the ensuing health consequences include sexually transmitted diseases, accidental injuries, acute respiratory infections, diarrhoea and tuberculosis. In the earliest phases of water resources planning, it is imperative to undertake a systematic review and to establish a priority ranking for the prevention and control of all health risks.

Parasitic infections caused by protozoa, such as African trypanosomiasis, Chagas disease, and cutaneous and visceral leishmaniasis, have geographical specificity. The effects on nutritional status and health of the ubiquitous intestinal helminths (*Ascaris*, hookworm and *Trichuris*) and protozoa (*Amoeba*, *Giardia* and *Cryptosporidia*) should not be ignored, since there are effective strategies of prevention and control (WHO, 1987c; Pawlowski et al., 1991).

The omission of reference to viral infections, which apart from hepatitis B are focal or geographically specific, is intentional. The occurrence of Japanese encephalitis has been closely associated with rice fields. This disease has created serious public health problems in India, Indonesia, the Republic of Korea, Sri Lanka, and some states of the former USSR. It appears to be

subsiding in China, Japan, and the Republic of Korea but is spreading in Bangladesh, India, Myanmar, Nepal, Thailand and Viet Nam (Umenai et al., 1985). Increases in incidence and distribution have been attributed to the switch from dry-land to irrigated rice cultivation and to the establishment of large modern pig farms. This disease is being reduced in several countries through immunization programmes and the control of the mosquito vector.

Sylvatic yellow fever in Brazil and West Africa is not a serious health problem, thanks to efficient vaccination coverage of the people at risk in water resources projects. The known distribution of the mosquito vectors of dengue, o'nyong nyong (in Kenya), and other arboviral diseases permits the prediction of risk in water development projects (Adekolu-John & Fagbami, 1980).

Ecological disruption at project sites

The construction of dams and formation of reservoirs and irrigation systems in tropical areas can cause rapid environmental degradation, and health risks may arise even before there is any awareness of the danger and before preparations have been made to overcome it (Burgis & Morris, 1987; Carpenter, 1987; Payne, 1986).

Every lake undergoes an evolution that gradually leads to its basin being filled up. Impounded lakes are subject to this process and their useful life can be predicted. It could be 500 years as in Lake Nasser, or less than 100 years as for many small dams. Watershed abuse leading to silting can reduce the life of a dam by more than half. Changes in the characteristics of the ecosystem represented by an artificial lake and the territory exposed to its influence occur more rapidly. In the first instance there are changes due to water retention: the flooding of territory, the rise in the groundwater level, the submersion of the terrestrial flora and fauna, and the forced departure of people and animals.

There are also gradual changes due to the accumulation of chemical products derived from the carbon, calcium, magnesium, nitrogen and phosphorus cycles that convert the ecosystem from an oligotrophic status with low nutrient concentrations to a eutrophic status, characterized by a richness of nutrients, a high density of certain populations, a very high biological oxygen demand, and a reduced number of species able to survive under these conditions. The surface of the water may acquire so much floating vegetation that fishing, navigation and even the passage of small boats become impossible. The accumulation of organic matter at the bottom and the consumption of oxygen for its oxidation eventually produce a zone where aerobic flora and fauna cannot exist. The fermentation of masses of dead algae and other

organisms sometimes causes such pronounced changes in the quality of the water that it becomes unsuitable for human purposes.

Efforts should be made to conserve the good qualities of water, not only for domestic use but also for the maintenance of a biological equilibrium compatible with fish farming, the control of floating and riverside vegetation, and other requirements. If an undertaking is to function as planned with turbines, irrigation, navigation, fishing and recreation, thorough knowledge and continuing surveillance of environmental conditions are required.

Changes in surrounding areas

Water resources development does not occur in isolation. The construction of a dam creates changes in both the upstream and downstream areas.

The initial concern is for the sources of the rivers feeding the lake, because it is often there that environmental degradation commences as a result of forest clearance, which is likely to be followed by a reduction or drying up of watercourses.

In forests, part of the rainwater returns to the atmosphere by evaporation, some is retained by the vegetation, and part is absorbed by the ground. Forest clearance upsets this balance, especially in humid tropical climates where the removal of plant cover leads to intense erosion and loss of soil fertility. The flow of rivers becomes irregular; rapid rainwater run-off causes floods and, during low-rainfall periods, streams may dry up or become blocked by sand deposits. This has both direct and indirect repercussions on the health of riverside populations, especially in poor countries. Swamps and pools, even if they exist for only a short time after flooding, become breeding places for blood-sucking insect vectors of disease and for snails that act as intermediate hosts.

Deforestation and erosion favour the rapid deposition of sediments and dissolved substances, especially if fertilizers and other chemical products are used in cultivated fields. The eutrophication of lakes is accelerated and species diversity is reduced.

In a few impounded lakes, forest flooding has, in the short term, resulted in enriched fish production. This is attributed to the response of plankton to the abundance of organic matter. In Africa, similar situations have encouraged fishing and populations have moved towards lakes where, because of more frequent contact with water containing *Biomphalaria* or *Bulinus* snails, the transmission of schistosomiasis has become more intense. Since the very favourable conditions of fish harvesting are short-lived, the economic status of these communities gradually deteriorates, and health conditions worsen if special measures are not taken.

In the downstream area, irrigated agriculture greatly simplifies the landscape and reduces the diversity of the fauna and flora.

Other changes accompanying this type of agricultural exploitation are: an increase in the area covered by water; the development of swampy regions and lagoons on surrounding terrain lower than the lake or on the fringes of cultivated land, as a result of the rise in the groundwater level; and some modification of the microclimate, with generally more constant humidity throughout the year and increased insolation.

Depending on their ecology, certain mosquito species may disappear or remain confined to small territories untouched by development. Other species may find more favourable conditions: increased water surface; favourable physical, chemical or nutritional factors in lakes, irrigation canals, excavations, marshes and seepage zones; and reduced numbers of predators, allowing the vectors' abundance to increase and enhancing their ability to transmit diseases. Both the extension of the aquatic habitat and the state of the ecosystem at a certain stage of eutrophication may favour the establishment or multiplication of snail species acting as intermediate hosts for schistosomes or other trematodes.

In tropical lakes the extraordinary growth of certain species of floating plants, particularly *Eichhornia crassipes* (water hyacinth), *Salvinia auriculata* (water fern) and *Pistia stratiotes* (water lettuce), provides rich support for the multiplication of important vector snails, especially *Bulinus* and *Biomphalaria* species, and of insects. Moreover, snail dispersal along watercourses is assisted by floating islets of vegetation. The spread of water hyacinth is having a severe economic impact on Lake Victoria, Lake Kyoga, and the Nile river source in Uganda. Submerged vegetation, of which *Ceratophyllum demersum*, *Polygonum senegalense* and *Utricularia inflexa* are examples, may support large snail colonies, especially when the aquatic plants are growing vigorously. Sometimes, as occurred in Lake Nasser, bottom algae can support a snail population that ensures the transmission of schistosomiasis.

Population movement and socioeconomic and demographic change

From the public health viewpoint, the new ecological conditions and their repercussions on the vectors and mechanisms of disease transmission take on their full significance in relation to socioeconomic and demographic changes occurring simultaneously (Goldsmith & Hildyard, 1985, 1986).

The original occupants of a flooded region have to bear the consequences of the abandonment of crops, field sites, and homes, and the reorganization of their lives. This is stressful even if new properties, dwellings and economic