

# Dams and Disease

Ecological design and health impacts of large dams, canals and irrigation systems

William Jobin



London and New York

# Contents

<i>Preface</i>	xi
<i>Acknowledgements</i>	xiii

## PART I

<b>Health opportunities</b>	<b>1</b>
-----------------------------	----------

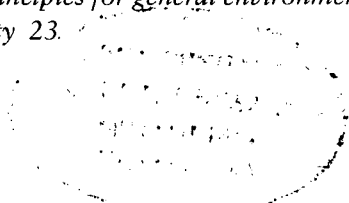
<b>1 Introduction</b>	<b>3</b>
-----------------------	----------

- 1.1 *Conflicts* 3
- 1.2 *Global crisis in tropical diseases* 5
- 1.3 *Why isn't it working?* 5
- 1.4 *Apocalypse* 8
- 1.5 *Strategies* 8
- 1.6 *A common vocabulary* 10

<b>2 General ecological aspects of dams and canals</b>	<b>12</b>
--	-----------

- 2.1 *Global impact of energy projects* 12
- 2.2 *Sustainable irrigation* 14
- 2.3 *Floodplain agriculture* 15
- 2.4 *Fisheries* 15
- 2.5 *Selective withdrawal from reservoirs* 18
- 2.6 *Simulated floods from dams* 18
- 2.7 *Salinity and water-logging* 20
- 2.8 *Deforestation* 21
- 2.9 *Erosion and sedimentation* 22
- 2.10 *Desertification* 22
- 2.11 *Global warming* 23
- 2.12 *Operational principles for general environmental sustainability* 23

<i>References</i>	27
-------------------	----



<b>3</b>	<b>Predicting health impacts in the Tropics</b>	<b>28</b>
3.1	<i>Health assessment principles</i>	29
3.2	<i>Dealing in death</i>	30
3.3	<i>Prediction of aquatic habitats</i>	33
3.4	<i>Prediction of insect vector and snail populations</i>	34
3.5	<i>Mammal population models</i>	38
3.6	<i>Prediction of disease transmission</i>	39
3.7	<i>Health opportunities</i>	44
3.8	<i>Professional relationships</i>	44
3.9	<i>Detailed health assessment procedures</i>	45
	<i>References</i>	58
<b>4</b>	<b>Water-associated diseases</b>	<b>60</b>
4.1	<i>Tropical diseases</i>	60
4.2	<i>Livestock diseases and other environmental concerns</i>	71
<b>5</b>	<b>Health opportunities through ecological design</b>	<b>74</b>
5.1	<i>Health opportunities</i>	74
5.2	<i>Economic advantages</i>	76
5.3	<i>Health strategies</i>	77
<b>PART II</b>		
	<b>The Americas</b>	<b>85</b>
<b>6</b>	<b>North America</b>	<b>87</b>
6.1	<i>Tennessee Valley Authority</i>	87
6.2	<i>Rocky Mountains</i>	91
	<i>References</i>	94
<b>7</b>	<b>Caribbean region</b>	<b>95</b>
7.1	<i>Puerto Rico</i>	97
7.2	<i>The Panama Canal</i>	150
7.3	<i>Dominican Republic and Nizao River dams</i>	157
	<i>References</i>	167
	<i>Further reading</i>	167

<b>8 South America</b>	<b>169</b>
8.1 <i>Brokopondo Dam in Surinam</i>	170
8.2 <i>Itaipu Dam in Brazil</i>	173
8.3 <i>Yacreta Dam in Argentina</i>	174
8.4 <i>Dams of Amazonas in Brazil</i>	174
8.5 <i>Other dams in Brazil</i>	176
8.6 <i>Hidrovia Canal Proposal</i>	176
References	176
Further reading	177
<b>PART III</b>	
<b>West Africa</b>	<b>179</b>
<b>9 Morocco</b>	<b>181</b>
9.1 <i>Oum Er R'bia River</i>	181
9.2 <i>Tadla Irrigated Area</i>	183
References	194
<b>10 Senegal River</b>	<b>195</b>
10.1 <i>A tragedy</i>	195
10.2 <i>General aspects of the Senegal River</i>	200
10.3 <i>Environmental and health impact assessments</i>	221
10.4 <i>Epidemics around the dams</i>	223
10.5 <i>The real tragedy of the Senegal River Valley</i>	246
10.6 <i>Proposal for the World Bank and the World Health             Organization</i>	246
References	247
Further reading	248
<b>11 Niger River</b>	<b>251</b>
11.1 <i>Operation Riz du Mopti</i>	251
11.2 <i>Chori River Reservoir in Kaduna State of             Nigeria</i>	254
11.3 <i>Reservoir on Gwaigwaye River in Katsina State of             northern Nigeria</i>	264
11.4 <i>Lake Kainji in Nigeria</i>	269
References	270
Further reading	271

<b>12 Volta River</b>	<b>272</b>
12.1 <i>Blackfly breeding and dam spillways</i>	272
12.2 <i>Lake Volta</i>	277
12.3 <i>Kpong Irrigation System</i>	284
References	285
<b>PART IV</b>	
<b>The River Nile and the Horn of Africa</b>	<b>287</b>
<b>13 River Nile</b>	<b>291</b>
13.1 <i>The Nile Waters Agreement of 1959</i>	291
13.2 <i>The Nile Waters Study for Sudan</i>	293
13.3 <i>Rapid sedimentation of Aswan Reservoir</i>	294
13.4 <i>Diseases related to the River Nile</i>	297
13.5 <i>Case study of Merowe Dam in Sudan</i>	303
13.6 <i>Historical analysis of Gezira–Managil Irrigation         System on the Blue Nile</i>	321
13.7 <i>Rahad Irrigation System</i>	356
13.8 <i>Owen Falls Dam on the upper River Nile in         Uganda</i>	360
References	365
Further reading	366
<b>14 Eritrea</b>	<b>369</b>
14.1 <i>Tekezze–Setit Project</i>	369
14.2 <i>Predicted impacts from project</i>	386
References	388
Further reading	389
<b>15 Somalia</b>	<b>391</b>
15.1 <i>Jubba River Dam upstream of Bardhere</i>	391
15.2 <i>Jubba River Valley</i>	393
15.3 <i>Environmental and socio-economic         assessment</i>	395
15.4 <i>Health impact analyses</i>	397
15.5 <i>Predicted bilharzia snail populations</i>	406
References	417
Further reading	417

<b>PART V</b>	
<b>Southern Africa</b>	<b>419</b>
<b>16 Zambezi River</b>	<b>421</b>
16.1 <i>Hydroelectric dams</i>	421
16.2 <i>Kariba Dam</i>	422
<i>References</i>	427
<b>17 Sabi River Basin in Zimbabwe</b>	<b>429</b>
17.1 <i>Night-storage ponds</i>	431
17.2 <i>Human travel range</i>	432
17.3 <i>Mushandike Irrigation Project</i>	434
<i>References</i>	435
<b>PART VI</b>	
<b>Middle East and Asia</b>	<b>437</b>
<b>18 Iran</b>	<b>439</b>
18.1 <i>Dez Irrigation Project</i>	440
18.2 <i>Return of bilharzia</i>	441
18.3 <i>Bilharzia Control Project</i>	441
18.4 <i>A computer model for simulating bilharzia transmission</i>	442
18.5 <i>Swiss cheese strategy</i>	445
18.6 <i>The edge is easy</i>	445
18.7 <i>Salinity and temperatures in Iran</i>	446
<i>References</i>	447
<b>19 Pakistan</b>	<b>448</b>
19.1 <i>Bolan Dam in Baluchistan</i>	448
19.2 <i>Ghazi-Barotha Power Canal</i>	454
<i>References</i>	462
<i>Further reading</i>	462
<b>20 Asia</b>	<b>463</b>
20.1 <i>China – Three Gorges Dam</i>	463
20.2 <i>Asian Archipelago</i>	466
<i>References</i>	476

**PART VII**

<b>Final summary</b>	<b>477</b>
<b>21 Final synthesis and specific guidelines</b>	<b>479</b>
21.1 <i>A new approach</i>	479
21.2 <i>Guidelines for health opportunity analyses</i>	481
21.3 <i>Design procedures to include health</i>	482
21.4 <i>Design characteristics for all diseases</i>	484
21.5 <i>Irrigation systems</i>	502
21.6 <i>Reservoirs</i>	509
21.7 <i>Other aspects of water-resource planning</i>	511
21.8 <i>Geographical analysis of bilharzia transmission foci</i>	513
References	514
<b>22 Appendix: ecology of major diseases associated with water in the Tropics</b>	<b>515</b>
22.1 <i>Diarrhoeal diseases</i>	515
22.2 <i>Malaria</i>	518
22.3 <i>Rift Valley Fever</i>	533
22.4 <i>Mosquito-borne encephalitis</i>	535
22.5 <i>Bilharzia</i>	536
22.6 <i>River blindness</i>	565
References	570
Further reading	571
<i>Glossary of chemical names</i>	573
<i>Index</i>	574