DAMS AND DEVELOPMENT

A NEW FRAMEWORK FOR DECISION-MAKING

THE REPORT OF THE WORLD COMMISSION ON DAMS



November 2000



Earthscan Publications Ltd, London and Sterling, VA

Table of Contents

....

Chair's Preface	i
Commissioners' Foreword	vii
Table of Contents	xi
List of Tables	xiii
List of Figures	xiii
List of Boxes	xiv
Acknowledgements	xix
Acronyms and Abbreviations	xvi
Executive Summary	xxvii
Chapter 1: Water, Development and Large Dams	1
Water and Development	3
Development and Large Dams	8
Large Dams as Instruments of Development	11
Problems Associated with Large Dams	15
Understanding the Large Dams Debate	17
Fulfilling the WCD Mandate – Process and Methodology	28
PART I: THE WCD GLOBAL REVIEW OF LARGE DAMS	35

Chapter 2: Technical, Financial and Economic Performance			37
Structure and Methodology			38
Construction Costs and Schedules			39
Irrigation Dams			42
Hydropower Dams			49
Water Supply Dams			56
Flood Control Dams			58
Multi-Purpose Dams			62
Physical Sustainability Issues			63
Findings and Lessons			68

Performance	
Terresterial Ecosystems and Biodiversity	
Greenhouse Gas Emissions	
Downstream Aquatic Ecosystems and Biodiversity	
Floodplain Ecosystems	
Fisheries	
Ecosystem Enhancement	
Cumulative Impacts	
Anticipating and Responding to Ecosystem Impacts Findings and Lessons	
Chapter 4: People and Large Dams: Social Performance	
Chapter 4. 1 eople and Large Dams. Social Terrormance	
Socio-Economic Impacts through the Project and Planning Cycle	
Lisplacement of People and Livelihoods	
Downstream Livelihoode	
Gender	
Cultural Heritage	
Human Health	
Equity and the Distribution of Costs and Benefits	
Findings and Lessons	
Chapter 5: Options for Water and Energy Resources	1
Development	
Agriculture and Irrigation	
Energy and Electricity	
Water Supply	
Integrated Flood Management	
Findings and Lessons	
Chapter 6: Decision-Making, Planning and Institutions	1
Decision-Making and the Political Economy of Large Dams	
Role of Foreign Assistance	
Planning and Evaluation	
Compliance	
Findings and Lessons	
PART II: THE WAY FORWARD	1(
Chapter 7: Enhancing Human Development: Rights, Risk	s
	1

From Global Review to Future Practise198Sustainable Human Development – A Global Framework199Trends and Challenges in Applying the New Development Framework203Rights and Risks – an Improved Tool for Decision-Making206Negotiated Agreements on the Basis of Rights and Risks208Conclusion210

Chapter 8: Strategic Priorities – A New Policy Framework	
for the Development of Water and Energy Resources	213
Gaining Public Acceptance	215
Comprehensive Options Assessment	221
Addressing Existing Dams	225
Sustaining Rivers and Livelihoods	234
Recognising Entitlements and Sharing Benefits	240
Ensuring Compliance	244
Sharing Rivers for Peace, Development and Security	251
Chapter 9: Criteria and Guidelines – Applying the	-
Strategic Priorities	259
Five Key Decision Points: The WCD Criteria	262
A Special Case: Dams in the Pipeline	276
A Set of Guidelines for Good Practice	278
Chapter 10: Beyond the Commission- An Agenda	
for Change	309
Strategic Entry Points for Follow-up	311
Taking the Initiative – Institutional Responses	-313
Continuing the Dialogue	. 316
A Call to Action	319

List of Tables

1.1	Dams currently under construction	10
1.2	Estimated annual investment in dams in the 1990s	11
1.3	Population density of selected river basins	17
4.1	Illustration of the services and benefits generated by large dams in the WCD	
	Case Studies	121
4.2	Profile of groups adversely affected by large dams: illustrations from WCD	
	Case Studies	124
5.1	Complementary approaches to flood management	161
6.1	WCD Case Studies: options assessment	178
9.1	Valuation methods	289

List of Figures

1.1	Annual fresh water withdrawals as a percentage of total resources withdrawn (1996)	6
1.2	Annual fresh water withdrawals per capita average (1987-95)	6
1.3	Distribution of the world's water	7
1.4	Selected water-stressed countries	7
1.5	Regional distribution of large dams at the end of the 20 th century	8
1.6	Construction of dams by decade (1900-2000)	9
1.7	Dams constructed over time by region (1900-2000)	9
1.8	Distribution of existing large dams by region and purpose	12
1.9	Agricultural land irrigated from dams	13
1.10	World map showing the regional location of the case studies, country studies,	
	cross-check survey dams, regional consultations, submissions and Forum members	31

2.1	Cost overruns on large dams	39
2.2	Average cost overruns for large dams	40
2.3	Project schedule performance	42
2.4	Achievement of command area	43
2.5	Actual irrigated area compared to planned targets over time	43
2.6	Economic performance of multilateral-financed irrigation dams	47
2.7	Project averages for actual versus hydropower generation	50
2.8	Actual versus planned hydropower generation over time	51
2.9	WCD case study hydropower performance: capacity and power generation	52
2.10 2.11 2.12 2.13	Multilateral bank evaluation results on the economic performance for hydropower dams Project averages of actual versus planned bulk water supply delivery Actual versus planned bulk water supply delivery over time Trends in dam safety assessments	54 57 57 65
2.14	Loss of active storage due to sedimentation	65
2.15	Loss of active storage due to sedimentation by reach of river	65
2.16	Waterlogging and salinity	67
3.1 3.2 3.3	Gross greenhouse emissions from reservoirs Greenhouse gas emissions from natural habitats Modification of annual regimes due to a hydropower dam, Colorado River at	76 76
3.4 3.5 3.6	Lee's Ferry, United States Fluctuations of daily streamflow regime due to hydropower peaking operations, Colorado River at Lee's Ferry, September Decline in species numbers but increase in fisheries productivity, Tucurui (a&b) Fragmentation in 225 large river basins	79 79 86 87
3.7	Anticipated and unanticipated ecosystem impacts	89
5.1	Schematic of electricity options	150
6.1	Development assistance for large dams, 1950-1999	171
6.2	Trends in provisions for participation and information disclosure	176
6.3	Trends in the implementation of economic and financial analyses	186
6.4	Trends in the implementation of environmental and social assessments	187
7.1 7.2	The WCD policy framework From rights and risks to negotiated agreements: a framework for options assessment and project planning	202 208
9.1	WCD Criteria and Guidelines strengthen other decision support instruments	260
9.2	Five key points in planning and project development	263
9.3	Preference matrix for ranking options	285

List of Boxes

1.1	New paradigm for water use	3
1.2	Types of large dams	11
1.3	Changing physical attributes and impacts of large dams	15
1.4	Central issues in the dams debate: past and present	21
2.1	Efficiency in the use of irrigation water	46
2.2	Economic and financial performance of the Columbia Basin Project	47
~2.3	Cost recovery for the Aslantas dam	48

4

2.4 2.5 2.6 2.7 2.8	Optimising operations with the aid of a computerised decision-support system Financial and economic performance of hydropower at Grand Coulee dam Economic performance and cost recovery of hydropower at Tucurui dam Flood protection in Japan From flood control to flood management in the United States	53 55 56 59 61
2.9	Cost recovery in a multi-purpose scheme: Grand Coulee and the Columbia Basin Project Dam safety in the United States	62 64
3.1	Mitigating and compensating for terrestrial impacts	75
3.L	Ureenhouse gas emissions at lucurui, Brazil	11
3.5	Minimizing impacts of changes in streamflow regime: environmental flow	70
J. T	requirements	81
3.5	Mitigation measure: fish passes	82
3.6	Restoring ecosystem function through managed floods	84
3.7	Cumulative impact of dams: the Aral Sea	88
3.8	Ecosystem restoration through decommissioning in the United States	92
4.1	Bringing electricity to the favelas in São Paulo, Brazil	101
4.2	Economic, socio-cultural and health impacts of livelihood displacement	103
4.3	Missing numbers of affected people: Sardar Sarovar project, India, and Pak Mun dam, Thailand	104
4.4	Economic value of downstream floodplains. Hadeija-Nguru, Nigeria	113
4.5	The Aswan High dam: a milestone in the history of archaeology	117
4.6	Mercury and human health at Tucurui	119
4.7	Royalties to communities: a Brazilian law for hydropower benefit-sharing	127
5.1	Conjunctive management of salinity	139
5.2	Cultivation techniques can reduce irrigation water use	141
5.3	A local approach to integrated water management, Rajasthan, India	144
5.4	Rainwater harvesting for domestic and agricultural use in China	144
).) 5.6	Wetland and flood plain agriculture	140
5.0	Flood resilience	162
J+1		102
6.1	WCD Case Studies: political decisions to build large dams	170
6.2	WCD Case Studies and Submissions: foreign involvement in dam projects	173
0.3 6.4	Nordic influence in the Pangani Falls Redevelopment Project, Tanzania	174
0. 4 65	Even late participation leads to a consensus resettlement plan: Salto Caivas dam	174
0.5	Brazil	177
6.6	Public participation and project acceptance: three scenarios from Austria	177
6.7	Environmental Impact Analysis (EIA): too little, too late	183
6.8	Licensing processes and duration	185
6.9	Allegations of corruption	187
6.10	Export Credit Agencies: competing for business versus common standards	189
6.11	WCD Case Studies: a compliance report card	190
7.1	Shared values and institutional practices – the UN Millenium Report	199
7.2	Human rights and human development	203
(.) 7 1	Voluntary risk takers and involuntary risk bearers	207
1.4	bood governance and the ON Millenium Report	209

~

A STATE

9.1	Health impact assessment	284
9.2	Cultural heritage impact assessment	285
9.3	Ghazi-Barotha, Pakistan	291
9.4	Design and cost of environmental flows - Pollan dam, Ireland	295
9.5	Benefits of improving fish passes	296
9.6	Financial assurances and the Environment Protection Agency, Victoria, Australia	304
9.7	Suriname Central Nature Reserve	305
9.8	Mendoza Province, Argentina	305
10.1	Priorities for strengthening the knowledge base	317

A Comment – Medha Patkar

321

ANNEXES		323
Ι	Bibliography	323
II	Glossary	344
III	WCD Work Programme – Approach and Methodology	349
IV	Reports in the WCD Knowledge Base	359
V	Dams, Water and Energy – A Statistical Profile	368
VI	United Nations Declarations	383
VII	Members of the World Commission on Dams	394
VIII	A Profile of the WCD Secretariat	397
INDEX		399

Dams and Development: A New Framework for Decision-Making