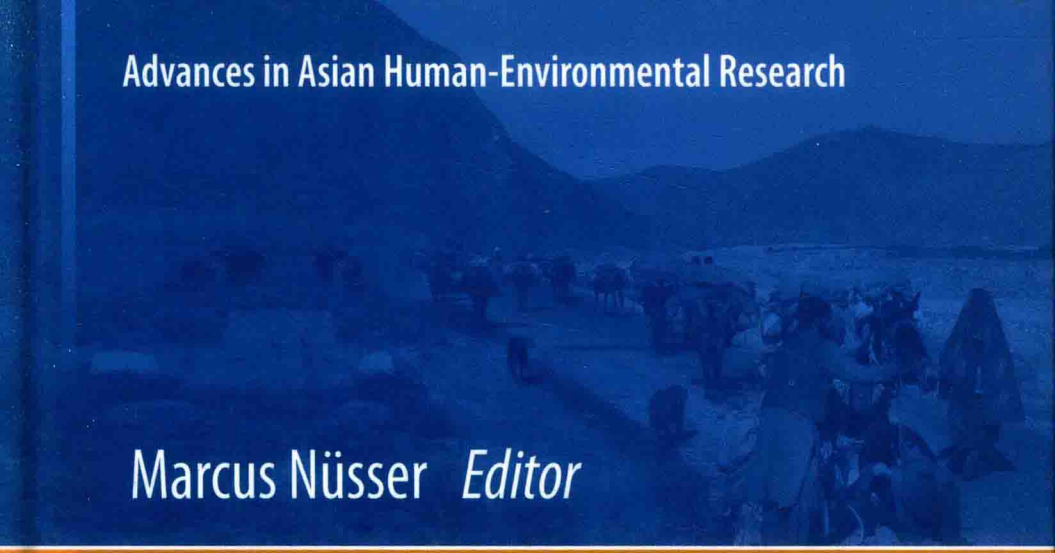
Advances in Asian Human-Environmental Research



Marcus Nüsser *Editor*

Large Dams in Asia

Contested Environments between Technological Hydroscapes and Social Resistance

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Large Dams in Asia

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Aims and Scope

The series aims at fostering the discussion on the complex relationships between physical landscapes, natural resources, and their modification by human land use in various environments of Asia. It is widely acknowledged that human-environment-interactions become increasingly important in area studies and development research, taking into account regional differences as well as bio-physical, socio-economic and cultural particularities.

The book series seeks to explore theoretic and conceptual reflection on dynamic human-environment systems applying advanced methodology and innovative research perspectives. The main themes of the series cover urban and rural landscapes in Asia. Examples include topics such as land and forest degradation, glaciers in Asia, mountain environments, dams in Asia, medical geography, vulnerability and mitigation strategies, natural hazards and risk management concepts, environmental change, impacts studies and consequences for local communities. The relevant themes of the series are mainly focused on geographical research perspectives of area studies, however there is scope for interdisciplinary contributions.

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Preface

Based on the underlying paradigms of modernisation and the concrete idea of implementation of large infrastructure projects, the quest for national development and improvement of local livelihoods has generated a strong boost for the demand of large dams in the Global South, especially in Asia. The belief in the panacea that gargantuan hydro-projects offer for the betterment of nations and peoples has run roughshod over other environmental and social concerns. Whereas these large-scale transformations of fluvial environments into technological hydroscapes serve to provide hydropower, flood control, and water supply for irrigation and industrial and urban uses, their massive adverse effects have evoked controversies of developmental and environmental impacts.

The contributions in this edited volume explore the various dimensions of the large dams controversy in Asia from a critical perspective. Most of these contributions originate from the research project 'Large dams: Contested environments between hydro-power and resistance', which ran from 2008 to 2011 as part of the Cluster of Excellence 'Asia and Europe in a Global Context: Shifting Asymmetries in Cultural Flows', Heidelberg University. I am grateful to the German Research Council (DFG) and the German Council of Science and Humanities (Wissenschaftsrat) for funding. The continuous support of the directorate and administrative staff of the cluster is gratefully acknowledged. I am indebted to Thomas Lennartz (Heidelberg), who worked hard to standardize formats of all individual contributions. It is hoped that this volume will be beneficial to those looking to gain an overview of the large dams debate. At the same time, the individual chapters may offer insights from case studies that should be useful to a specialist audience.

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Abbreviations

ADHPL	Allain Duhangan Hydro Power Limited
BCE	before the Common Era
BNP	Bhakra Nangal Project
CAS	Chinese Academy of Sciences
CASS	Chinese Academy of Social Sciences
CB ratio	cost-benefit ratio
CCP CC	Chinese Communist Party Central Committee
CDM	Clean Development Mechanism
CE	Common Era
CER	Certified Emission Reduction
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CS	Cadastral Survey
CV	coefficient of variation
DNA	Designated National Authority
DOE	Designated Operational Entities
DVC	Damodar Valley Corporation
EAC	Expert Appraisal Committee
EF	exceedance frequency
EFR	environmental flow requirement
EIA	environmental impact assessment
ENSO	El Niño/La Niña-Southern Oscillation
ET	emission trading
GIS	geographic information systems
GHG	greenhouse gas
GoS	Geography of Science
GUP	Government of Uttar Pradesh
GWIL	Gujarat Water Infrastructure Limited
HEC	Hydrologic Engineering Center
HFC	hydrofluorocarbon
IRS	Indian Remote Sensing

ICOLD	International Commission on Large Dams
IFC	International Finance Corporation
JI	joint implementation
KWDT	Krishna Water Disputes Tribunal
LISS	Linear Imaging Self-Scanning
MoEF	Ministry of Environment and Forest, Government of India
MPRVD	Multi-purpose River Valley Development
MRO	manager reservoir operation
MW	megawatt
N_2O	nitrous oxide
NIR	near infrared
NGO	non-governmental organisation
NRSA	National Remote Sensing Agency
P	precipitation
PAP	Project Affected Person
PDD	Project Design Document
PFC	perfluorocarbon
Q	hydrologic discharge
R&R	resettlement and rehabilitation
RBO	River Basin Organisation
RS	Revision Survey
SANDRP	South Asian Network on Dams, Rivers and People
SD	standard deviation
SoI	Survey of India
SSP	Sardar Sarovar Project
SSK	Sociology of Scientific Knowledge
STS	Science and Technology Studies
SWIR	short-wave infrared
TBVSS	Tehri Bandh Virodhi Sangharsh Samiti (Committee to Oppose the Tehri Dam)
THDC	Tehri Hydro Development Corporation
TINA	There Is No Alternative
TVA	Tennessee Valley Authority
UNFCCC	United Nations Framework Convention on Climate Change
WAPDA	Water and Power Development Authority (Pakistan)
WCD	World Commission on Dams
WFD	Water Framework Directive
WWF	World Wildlife Fund

Units of Measure

ft^3/s	cubic feet per second (cusec)	1 $ft^3/s \approx 0.028\ m^3/s$
GW	gigawatt	1 GW = 1,000,000,000 W
ha	hectares	1 ha = 10,000 m^2
kV	kilovolt	1 kV = 1,000 V
maf	million acre feet	1 acre foot $\approx 1233.5\ m^3$
mha	million hectares	
MW	megawatt	1 MW = 1,000,000 W

Contents

Chapter 1
Technological Hydroscapes in Asia: The Large Dams Debate Reconsidered

Marcus Nüsser

Abstract Large dams have evoked contentious debates about the trajectories and effectiveness of development, environmental impacts and social justice. As is especially the case in the countries of the Global South, particularly in Asia, the construction and operation of large dams are amongst the most prestigious but also most sensitive development issues. These large-scale transformations of fluvial environments into technological hydroscapes serve to provide hydropower, flood control and water supply for irrigation, industrial and urban uses. In turn, negative socioeconomic consequences through displacement, resettlement and insufficient compensation as well as adverse environmental impacts emerge. From a political ecology perspective, these massive development interventions can be seen as contested environments shaped by distinct actor constellations and the underlying aspirations of modernisation and social resistance. This introductory chapter explores the various dimensions of the large dams controversy in Asia and retraces the historical course of the debate in the context of changing development paradigms, underlying power asymmetries and the social constructions of nature.

Keywords Large dams • Hydroscapes • Socio-hydrology • Development • Politicised environments

1.1 Framing the Large Dams Debate

Being among the most massive infrastructure projects built worldwide, large dams provide hydroelectric power, flood control and water supply for irrigation, industrial and urban uses. Large dams constitute powerful symbols of modernisation, national

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prestige and human dominance over nature. At the same time, these gigantic 'tools' for the management of water resources have evoked controversial debates on development paradigms, development effectiveness, social justice and sustainability (e.g. McCully 2001; Khagram 2004; Kreutzmann 2004; D'Souza 2006). The economic benefits of dam building for hydropower generation and effective water management for irrigated agriculture, drinking water supply and flood control are almost always in contrast to the adverse consequences for local populations and negative environmental impacts. Among the most common socioeconomic concerns are insufficient compensation for displaced people and the related lack of long-term development perspectives. Against this backdrop, the main arguments in the large dams controversy are rooted in the classical development theories of modernisation and dependency. Large dams are textbook examples that highlight some of the most sensitive and contested development issues as well as complex socio-hydrological interactions. Although a huge body of literature on large dams and river control has been published over the past decades and the principal arguments are repeated in the context of various case studies, the transformation of fluvial environments are seldom framed within a larger picture of contested development paradigms across changing historical and political contexts.

According to the inventory of the World Commission on Dams (WCD) in 2000, there are more than 45,000 large dams,[1] all but 5,000 of them built since 1950. Most of these dams were constructed in Asia, with China and India being among the most prolific dam-building countries in the world (Gleick 1998, p. 78; McCully 2001, p. 66). China has by far the world's largest installed hydropower capacity, with aspirations for further expansion (Gleick 2012, p. 129). Moreover, Chinese funding institutions and engineering companies are increasingly involved in dam projects in neighbouring and overseas countries (Brewer 2007; Gleick 2012, p. 308). China's involvement in the construction of the Diamer Basha Dam in the Indus Valley of northern Pakistan, with the promise of several thousand experienced workers from the Three Gorges Dam, is just one example. This dimension of technology and knowledge transfer is in many ways similar to the expertise flowing from the Tennessee Valley Authority (TVA) in the USA to India in the 1950s. In the Himalayan region, the governments of India, Pakistan, Nepal and Bhutan are transforming the upper reaches of the mountain drainage system into the subcontinental powerhouse of South Asia at an unprecedented pace. In the same direction and at an even faster rate, China taps the water resources of the Tibetan

[1] In order to define large dams, the *International Commission on Large Dams* (ICOLD), a professional organisation of the dam-building industry, established in 1928, offers a set of criteria. According to their well-established definition, a large dam is one whose height exceeds 15 m or whose height is between 10 and 15 m, if it meets at least one of the following conditions: the crest length of the dam is not less than 500 m, the spillway discharge potential exceeds 2,000 m^3 per second or the reservoir volume is not less than 1 million m^3. A major dam is defined by ICOLD as a dam meeting at least one of the following four requirements: the dam is at least 150 m high, the dam volume exceeds 15 million m^3, the reservoir storage capacity exceeds 25 billion m^3 or the installed electrical generation capacity is at least 1,000 MW.

Photo 1.1 The controversy of the Yamdrok Yumtso Lake. This unique freshwater lake, located at an altitude of 4,400 m on the Tibetan plateau, is tapped to power a 90 MW electric generator (Photograph: Marcus Nüsser, 12 May 2002)

plateau to cope with growing water and energy demands in the region (Photo 1.1) and in the urban agglomerations of China. The importance of the Asian high mountain belts as sources of freshwater supply for the adjoining lowlands has led to them being characterised as 'water towers' (Viviroli et al. 2007; Viviroli and Weingartner 2008). Apart from this fundamental hydrological attribute, the Himalayan region, including the Tibetan plateau, increasingly gains the additional function of a 'power tower', intensifying and diversifying the resource transfer from the mountains to the plains of the subcontinent (Erlewein and Nüsser 2011, p. 302; Erlewein 2012, p. 33). Most prominent examples are the northern states of India, namely, Himachal Pradesh, Uttarakhand, Sikkim (Photo 1.2) and Assam, which supply the economic centres in the adjoining lowlands with hydroelectric energy. In addition, India supports dam building in the upper riparian countries of Bhutan and Nepal so as to fulfil the nations' energy demands. All of these South Asian countries are affected by chronic energy deficiencies, resulting in load shedding to various degrees. The precarious energy shortage became most obvious when a huge electricity blackout, affecting 1.2 million people, occurred in India in July 2012 and gained international media attention. To date, the reality remains the same for many people along the Himalayan arc, from Pakistan to Nepal, who only receive a few hours of power supply on a rotational basis. Against this background and the states' economic development aspirations, the government's perspectives are to increase the nation's hydropower capacities for domestic and industrial use. The same holds

Photo 1.2 Damming Sikkim: A cascade of 36 hydropower plants are planned along the Teesta River in one of India's Himalayan states (Photograph: Marcus Nüsser, 9 April 2011)

true for the expansion of irrigation systems so as to improve food security and drinking water supplies. Juxtaposed to these potential benefits of dam building is a swath of negative externalities.

Worldwide, 40–80 million people have been displaced due to dam construction and related flooding (World Commission on Dams 2000, p. 16). For the Three Gorges Dam in China alone, almost 1.2 million persons were displaced (Li et al. 2001, p. 201; Yardley 2007). The affected people, sometimes referred to as 'oustees', who are mostly excluded from planning processes, are then confronted with an endangered livelihood security, which is further compounded by inadequate compensation for their material and cultural losses. Whereas local residents are considered 'refugees in an unacknowledged war' (Roy 2001, p. 65) by environmental and social activist groups, nation-states identify them as beneficiaries of the prospective improvements. Struggles over power between nation-states, international funding agencies and industries, non-governmental organisations (NGOs) and adversely affected persons testify to a 'politicised environment' in the sense of Bryant and Bailey (1997, p. 28). Central to this concept is the recognition that environmental conflicts cannot be understood without taking into consideration the political and socioeconomic contexts within which they emerge. Apparently, arguments of actors on the national level are linked to economic interests within and across countries and influenced by the international dam-building industry and multilateral funding institutions. Both advocates and opponents of large hydro-projects form coalitions to

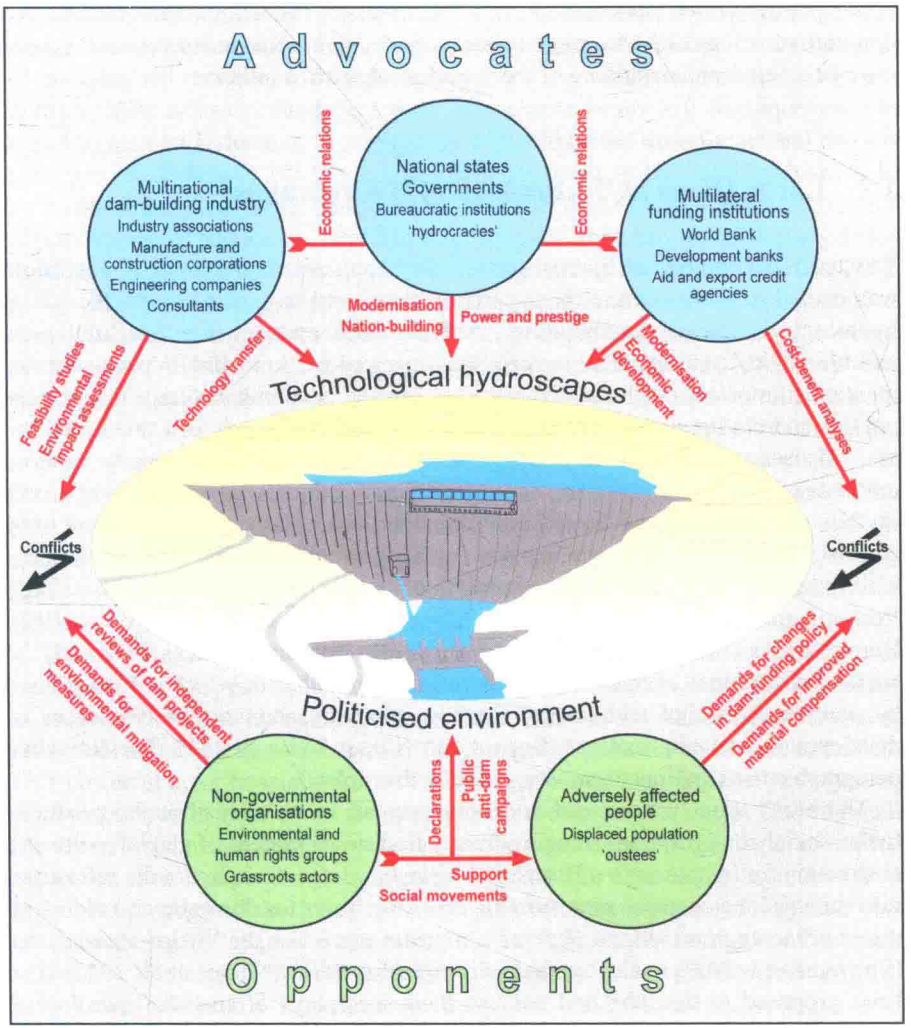

Fig. 1.1 The politicised environment and the principal actor constellation in the large dams debate (Modified after Nüsser 2003, p. 22)

strengthen their position during the planning and implementation phase. The actor-orientated approach of political ecology provides an ideal framework to identify the character, scope and dynamics of these contested politicised environments, where place-based and non-place-based actors are involved (Nüsser 2003; Baghel and Nüsser 2010, Fig. 1.1). Moreover, changing social constructions of the role of the environment in fostering development shape struggles over power, interests and institutions (Adger et al. 2001; Watts and Peet 2004; Agrawal 2005). The deep-rooted differences between various actor groups cannot be simplified as modernised

hydro-politics versus environmental fundamentalism. Instead, this problematic and dynamic situation calls for a more suitable conceptual framework which can help to provide a better understanding of these socioecological conflicts.

1.2 Large Dams as Technological Hydroscapes

The term 'technological hydroscapes', which appears in the title of this book, was coined in the context of a research project[2] and is used to frame the socio-hydrological nature of dam building and river control under changing technological and ideological settings. The concept was inspired by Appadurai's proposed elementary framework of global disjunctures between economy, ecology, technology, politics and culture and especially of his notions of 'technoscapes', 'mediascapes' and 'ideoscapes' (Appadurai 1996, p. 33). Large dams are not merely material artefacts of gigantic engineering and infrastructure projects, or central components in the transformation of fluvial environments and energy generation, but they are also expressions of prevailing development paradigms. The term 'technological hydroscapes' combines the constructs of 'waterscapes' (Swyngedouw 1999), 'technoscapes' (Appadurai 1996) and 'energyscapes' (Kaisti and Käkönen 2012). Here, 'scapes' are not considered as physically delimited spaces or merely as social constructions of nature, but rather as dynamic entities which are constituted by complex flows of technology, funding, ideology and various discourses of development and environment (Baghel and Nüsser 2010, p. 241). The following paragraph contextualises these 'scapes' with examples.

The broad term 'waterscape' conceptualises all forms of historically produced hydro-social configurations, ranging from a traditional system of glacial meltwater abstraction for irrigation in a Himalayan village to large-scale hydraulic infrastructure such as long-distance pipe systems diverting water for domestic and industrial use in urban agglomerations. Various composite terms like the 'hydro-social cycle' (Swyngedouw 2009) or the 'socio-hydrological system' (Nüsser et al. 2012) have been proposed to describe and analyse these interplays of specific hydrological conditions and dynamics, socioeconomic development processes and institutional arrangements. In the context of large dams, the technological dimension of these socio-hydrological interventions is of utmost importance and leads to the use of the term 'technological hydroscape'. Dam building and river embankments evolved with improvements in engineering knowledge, construction skills and progress in hydrological analyses. Current examples of technological progress are the run-of-river power plants. These designs require smaller reservoirs, from which water is diverted into head race tunnels before reappearing some kilometres down the valley,

[2]The research project 'Large dams: Contested environments between hydro-power and resistance' was funded from 2008 to 2011 as part of the Cluster of Excellence 'Asia and Europe in a global context: Shifting asymmetries in cultural flows', Heidelberg University.