Political Ecology of Large Dams: a Critical Review

Marcus Nüsser

with 4 figures

Dedicated to Prof. Dr. Eckart Ehlers on the occasion of his 65th birthday

Politische Ökologie von Hochdämmen: Ein kritischer Überblick
Zusammenfassung: Die Diskussion über die weit reichenden ökologischen Wirkungen und sozioökonomischen Konsequenzen großer Staudammvorhaben wird seit Jahrzehnten kontrovers geführt. Insbesondere in den Ländern des Südens sind Bau und Betrieb großer Staudammprojekte mit fundamentalen Entwicklungsfragen verknüpft. In der gegenwärtigen Diskussion gelten Großprojekte wie der Sardar-Sarovar-Damm in Indien oder das „Drei-Schluchten-Projekt" in China als prominente Symbole in diesem Konflikt. Mangelnde Umweltverträglichkeit sowie ungenügende materielle Kompensation und fehlende ökonomische Perspektiven für die von Umsiedlungsmaßnahmen betroffenen Bevölkerungsgruppen bilden die wichtigsten Probleme. Trotz der anhaltenden Kontroverse um Großdämme wird die Debatte zwischen Befürwortern und Gegnern in den letzten Jahren auch durch Bemühungen um gemeinsame Lösungen und die Suche nach einem Ausweg aus dem Dilemma unterschiedlicher Entwicklungsperspektiven gekennzeichnet. Der vorliegende Beitrag beleuchtet den gegenwärtigen Diskussionsstand und zeigt die wesentlichen Umwelt- und Entwicklungsprobleme am Beispiel des Wasserbauprojektes im Hochland von Lesotho (LHWP), eines der größten technischen Infrastrukturprojekte im subsaharischen Afrika.
Schlüsselwörter: Staudämme, Wassernutzung, Entwicklung, Umweltfolgen, Umweltkonflikte, Politische Ökologie, Lesotho, Südafrika

Abstract: Ecological impact and social consequences of large dam projects are discussed in a highly controversial manner. Particularly in the countries of the South, construction and operation of large dams are among the most prestigious but also sensitive development issues. Presently, mega-projects such as the Sardar Sarovar Dam in India or the "Three Gorges Project" in China serve as prominent symbols of the conflict. Economic interests of dam-building for hydropower and water supply are generally linked to far-reaching and often negative environmental and social consequences. Among the most common socio-economic problems are insufficient material compensation to people adversely affected or dislocated by dam-building and the subsequent lack of economic perspectives available to many rural communities. Despite ongoing controversy over large dam projects, the discussion of the last years is also characterized by efforts to find common ground between advocates and opponents, and to possibly find a way out of the dilemma of different development perspectives. This paper reviews the contemporary discussion on large dams. The Lesotho Highlands Water Project (LHWP), the largest civil engineering and infrastructure project in sub-Saharan Africa, is used as an example to illustrate some of the most important environmental and developmental issues.
Keywords: Dams, water use, development, environmental impacts, environmental conflicts, political ecology, Lesotho, South Africa

1. Introduction: problems and controversial perspectives

Large dams are among the greatest single structures built by humanity. They serve as powerful symbols of modernization, national prestige, and of human dominance over nature (McCully 1996). Despite the long history of water management in human civilization by means of dams and reservoirs, extensive construction of large dams did not commence until the middle of the twentieth century. Large dam-building paralleled with improvements in engineering skills, construction technology and progress in hydrologic analysis. The big dam era started in the United States with the construction of Hoover Dam on the Colorado River in the 1930s. After the Second World War, many large dams were built in the Soviet Union, following Stalin's concept of a "transformation of nature into a machine for the communist state". Subsequently, widespread construction of large dams started in the developing countries, with India and China as the most prominent examples of dam-building nations (McCully 1996, Gleick 1998). By the year 2000, the world has built over 45,000 large dams and approximately 500,000 km² of land surface has been artificially inundated by reservoirs (International Commission on Large Dams 1998, World Commission on Dams 2000). Generation of hydropower is among the most prominent purposes of large dam construction. In the 1990s, about 640,000 megawatts of installed hydroelectric capacity produced nearly 20 % of the world's

total supply of electricity (Gleick 1998). Other basic purposes of large dams include the seasonal or annual storage of water for human consumption, agrarian and industrial production and for the reduction of flood peaks.

Besides their global economic importance, large dams have become the focus of intense debate because of their frequently severe environmental impact and socioeconomic consequences. Whilst advocates of dam construction generally stress arguments of modernization, technological progress and water supply in drought-prone regions as incentives for regional or national economic development, opponents emphasize a whole range of negative environmental aspects and high socioeconomic and political costs of involuntary resettlement. Depending on their specific mode of operation, the main environmental impacts of dams include fragmentation of riverine ecosystems, changes in flow patterns, modification of erosion and deposition processes, species extinction in freshwater and wildlife habitats, and loss of water by evaporation and contamination. The social costs of involuntary resettlement due to large-scale hydro projects are as dramatic as the ecological ones. It is estimated that 40–80 million people worldwide are forced of their settlements, agricultural lands, forests and other resources due to dam related flooding (World Commission on Dams 2000). In addition to the displaced population, other people affected by dam construction include rural dwellers residing downstream from such dams. They are often neglected in project assessments because it is assumed that they will benefit from the project; however, there are frequently significant negative downstream impacts (Scudder 1997). A large number of case studies in developing countries provide evidence that the adverse impacts of large dams have fallen disproportionately on subsistence farmers, indigenous peoples, and ethnic minorities, who often rely on common property regimes of resource utilization. Reservoirs inundate floodplain soils, woodlands, wildlife, fisheries and forests, which many local communities subsist and depend on to secure their livelihoods. Especially in mountain environments, dams force displaced inhabitants into the upper valleys, where they may cause further degradation of natural resources. Moreover, drastic natural hazards include reservoir-induced seismicity which may lead to dam collapse and catastrophic floods (Chao 1995).

The severity of the aforementioned impacts have inevitably generated long lasting conflicts concerning specific results of dam-building and general development perspectives associated with the construction of large dams. Prominent examples of current controversy are the "Three Gorges Project" on the Yangtze River in China (Fearnside 1988, Gleick 1998, McCully 2001), the Sardar Sarovar Dam on the Narmada River in India (Morse & Berger 1992, Gadgil & Guha 1994), the Ralco Dam on the BioBio River in Chile (Sears & Bragg 1987, Orrego 1997) and the Southeast Anatolia Project in Turkey (Öktem 2002). Other controversial projects such as Brazil's Tucurui Dam, Pakistan's Tarbela Dam and Thailand's Pak Mun Dam are discussed in detailed case studies by the World Commission on Dams (2000). Earlier projects such as the Aswan High Dam in Egypt (completed 1970) or the Akosombo Dam in Ghana (completed 1965) remain contentious in terms of their long-term impacts on the environment, demography and economy of their surrounding regions. A number of critical analyses and overviews on the dam-building debate have been published during the past 20 years (e. g. Goldsmith & Hildyard 1984, Petts 1984, McCully 1996, 2001).

Large dams: classificatory aspects and definitions

Dams and reservoirs serve a variety of functions. The most important purposes are irrigation, water supply, hydropower generation, flood control and navigation. Multi-purpose dams meet at least two of these objectives. The two main categories of dams are reservoir storage projects, which impound water for seasonal or annual storage and run-of-river dams, which create a hydraulic head in the river to divert some portion of the drainage to a canal or power station. There are three main types of dam design, embankment, gravity and arch, which are selected mainly according to site topography and geological setting. Embankment dams (e. g. Nurek in Tajikistan, Tarbela in Pakistan, Tehri in India, Mohale in Lesotho) are built of excavated natural materials and they are usually triangular in cross-section. These most massive structures can be constructed on soft and unstable riverbeds because their broad base distributes weight over a wide area. Gravity dams (e. g. Grande Dixence in Switzerland, Bhakra in India) are constructed of concrete and / or masonry. The basically thick walls mainly rely on their own weight and internal strength for stability. Mostly they are built across relatively narrow valleys with firm bedrock. Concrete arch structures (e. g. Katse in Lesotho) with their curved heads facing upstream are limited to narrow canyons with strong rock walls. Important structural features of dams are spillways that are used to discharge water when the reservoir threatens to become dangerously high. The tailrace is a pipe or channel through which turbined water is discharged into a river downstream from a dam.

In order to define large dams, the *I*nternational *C*ommission *on L*arge *D*ams (ICOLD), offers a set of criteria. 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. According to these criteria, there are about 45,000 large dams, all but 5,000 of them built since 1950. 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 1000 megawatts. With a height of 300 m, the Nurek Dam in Tajikistan, completed in 1980, is currently the world's highest dam. The Volta Reservoir behind Akosombo Dam in Ghana forms the largest artificial lake on Earth (8,500 km^2). It flooded more than 5 % of the country and displaced 80,000 people (McCully 1996, 2001, Gleick 1998, World Commission on Dams 2000).

2. The main actors in the large dam debate

The deep-seated differences between various interest groups cannot be simplified as modernized hydro politics versus environmental fundamentalism. Analyzing the conflicts and development models associated with dam construction using an actor-orientated approach of political ecology seems more appropriate (e. g. BLAIKIE 1995, 1999, BRYANT & BAILEY 1997, BRYANT 1999). The controversy between advocates and opponents of large dams takes place in a politicised environment (Fig. 1). Central to the concept of a politicised environment (BRYANT & BAILEY 1997) is the recognition that environmental problems and various dimensions of environmental conflicts cannot be understood in isolation from the political and economic context within which they emerge. Thus, problem-orientated studies need to focus on the role of place-based and non-place-based actors involved in environmental change and land use conflicts. The key types of actors in the discussion on large dams are national states and governmental institutions, dam-building industry associations and engineering companies, multilateral funding institutions, environmental non-governmental activist groups, and the adversely affected people. Both advocates and opponents of large dams form coalitions in order to strengthen their position and influence in the planning and implementation phase and to reinforce their perspective.

National states and governments are among the most important actors in large dam planning. In many cases, large dams have become symbols of nation-building in developing countries, or icons of the ruling autocratic regimes. Powerful parastatal agencies and bureaucratic institutions were established in order to plan and realize such big projects (e. g. Pakistan's Water and Power Development Authority, Lesotho Highlands Development Authority). Apparently, such centralized authorities and bureaucracies have a vital self-interest to continue their dam-building business for the purpose of maintaining their power and prestige. The dam-building industry, consisting of multinational engineering, consultant, equipment manufacture and construction corporations is the most important driving force outside the developing countries. These companies and professional groups are organized in associations such as the *I*nternational *C*ommission *o*n *L*arge *D*ams (ICOLD), established in 1928. The leading association constitutes an active lobby for the propagation of dams by holding international meetings and congresses and by the creation of technical committees of experts in dam-building. Advantages of technology transfer and subsequent economic progress are frequently expressed motivations for dam-building in developing countries. Feasibility studies and environmental impact assessments are carried out by consultant companies, some of which are also directly involved in dam-building. Dependent electricity-intensive industries (i. e. aluminium smelters) and agribusiness interests are intimately linked to the dam-building lobby.

The World Bank is the most important international public institution and multilateral financing agency in the dam-building industry. During the past decades, the World Bank approved loan packages for a large number of dams, including some of the world's most controversial mega-projects. In order to react to the massive and well-publicised protests of environmental non-governmental organizations and social activist groups, the *O*perations *E*valuation *D*epartment (OED) of the World Bank began a review of large dam projects completed between 1960 and 1995 (World Bank 1996). The dams were classified according to their economic justification. Further, it was evaluated whether or not the dams satisfied the impact mitigation and management policies existing at the time of their approval, and whether they could have been planned so as to satisfy the more demanding policies that the World Bank had introduced over the intervening years. Whereas 90 % of the dams reviewed

Fig. 1 The main actors in the controversial large dam debate
Die Hauptakteure in der kontroversen Debatte um große Staudämme

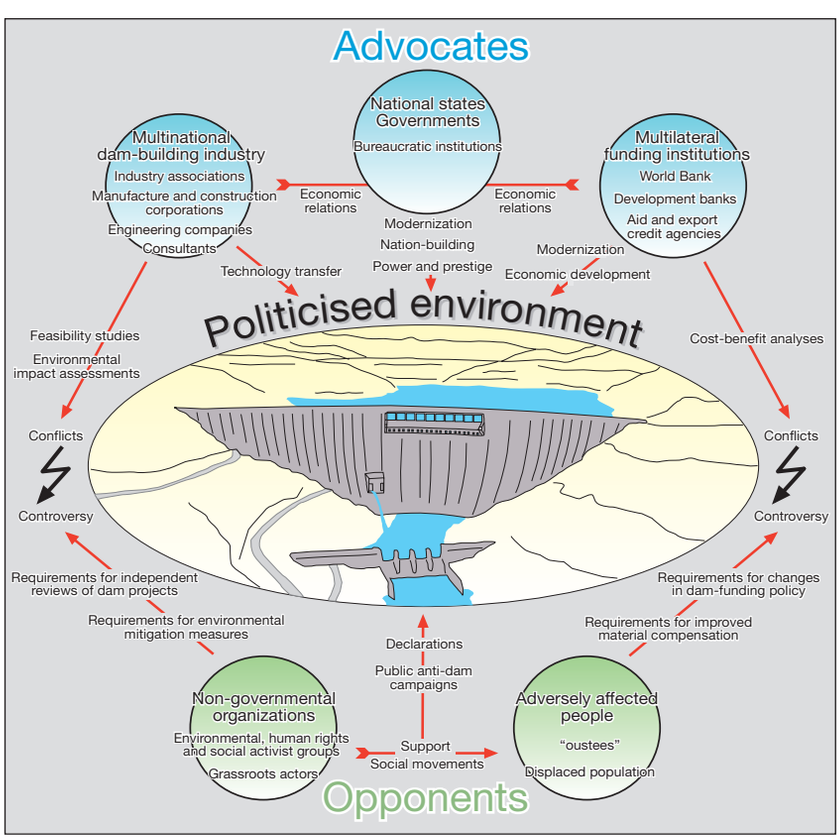

Fig. 2 The *L*esotho *H*ighlands *W*ater *P*roject (LHWP; Sources: Lesotho Government 1994, LHDA 1995, MAFAKANE 1999; Cartography: G. BRÄUER-JUX, M. NÜSSER)
Das Lesotho-Hochland-Wasserprojekt (LHWP; Quellen: Lesotho Government 1994, LHDA 1995, MAFAKANE 1999; Kartographie: G. BRÄUER-JUX, M. NÜSSER)

met the standards applicable at the time of approval, only about 25 % were implemented so as to comply with the World Bank's current guidelines and policies. On the other hand, the review concluded that mitigation of the adverse social and environmental consequences of large dams would have been feasible and economically justified in roughly 75 % of the cases (World Bank 1996, DORCEY et al. 1997). As a significant consequence of recent policy changes, the World Bank has cut the number of dams it is funding to well under half of its peak level of the early 1980s (MCCULLY 2001). Other major funding institutions involved in dam-building are the multilateral development banks for Africa, Asia and Latin America, as well as the bilateral aid and export credit agencies of most industrialized countries.

Since the mid-1980s, the international anti-dam movement, a network of environmental and human rights groups, plays an important role in the debate. Their basic demands include independent impact assessments of projects and participation of affected people in the planning process. Working together with local groups, these "grassroots" actors are able to launch powerful public opposition campaigns and declarations such as the Manibeli Declaration (1994), which calls for a moratorium on World Bank funding of large dams until a number of conditions are met. Non-governmen-

tal organization such as the *I*nternational *R*ivers *N*etwork (IRN, www.irn.org) based in Berkeley and *Narmada Bachao Andolan* (save the Narmada Movement) in India occupy key positions in this context. The remaining major actors in the debate include the adversely affected people who suffer negative economic, social and cultural effects by construction works, impoundment, and alteration of fluvial systems. Social scientists increasingly use the term "oustees" for the displaced populations.

Despite ongoing controversy between advocates and opponents of large dam projects, discussion during the last years is also characterized by efforts to build a common understanding among stakeholders and to find a way out of the dilemma of different development perspectives. Founded in 1997, the World Commission on Dams (WCD, www.dams.org) addresses the conflicting viewpoints on large dams. The participating representatives of governments, industry, financial institutions, non-governmental organizations and affected people's organizations comprise the main actors in the debate. The commission's final report (World Commission on Dams 2000) provides the first comprehensive global and independent review of the performance and impacts of dams and presents a new framework for water and energy resources development with criteria, guidelines and procedures for future decision-making.

3. The mountain Kingdom of Lesotho: water tower for southern Africa

The case of the *L*esotho *H*ighlands *W*ater *P*roject (LHWP) between the landlocked mountain Kingdom of Lesotho and the Republic of South Africa may serve as a case study to illustrate the general set of economic and political problems associated with large dams. The project is one of the world's largest and most sophisticated inter-basin water transfer schemes currently under construction. The Lesotho Highlands receive the highest rainfall in the region and are the origin of some of the most important rivers in southern Africa. By damming the headwaters of the southwest-flowing Senqu River (Orange River in South Africa), the LHWP is designed to divert about 50 % of the water from the Senqu basin northwards into the Vaal River system for use in Gauteng, the metropolitan and industrial heartland of South Africa. Located ca. 300 km north of Lesotho, Gauteng includes the major cities of Johannesburg and Pretoria, containing about half of South Africa's industry and generating almost 80 % of the nation's mining output (NEL & ILLGNER 2001, NÜSSER 2001).

The main objective of the World Bank supported multi-purpose LHWP is to ensure sufficient water supply for urban expansion and industrial development in South Africa. On the other hand, royalties from the sale of water (called "white gold" by project authorities) will be the largest single source of foreign exchange for Lesotho. Furthermore, the project is designed to provide hydro-electric power and considerable infrastructure for Lesotho. LHWP-related road building und upgrading includes the Southern Access Road from Thaba Tseka to the Katse Dam and the Northern Access Road from the lowlands to the Katse site (Fig. 2). Infrastructure facilities of the project also comprise large base camps for labourers and contractors working at the construction sites and electric power transmission lines (Fig. 3).

The concept of capturing Lesotho's rainfall through dams and transferring the water to the metropolitan heartland of South Africa can be traced as far back as the mid-1950s. After diverse negotiations, South Africa's apartheid government and a military regime in Lesotho signed the treaty on the LHWP in 1986 (HORTA 1995). The project consists of four proposed phases, intended to successively increase water supply by integrating further components. Construction started in 1991, with phase 1A comprising the Katse Dam (Figs. 3 and 4) and reservoir (1,950 million m^3) in the central highlands, an 82 km transfer and delivery tunnel system reaching to the Ash River across the border in South Africa, and the Muela hydropower plant (72 MW). This phase was commissioned in 1998 and an average of 17m^3/sec water is now being delivered to South Africa. Phase 1B, comprising Mohale Dam and reservoir (958 million m^3), some 40 km south-west of Katse, a 32 km transfer tunnel between Mohale and Katse reservoirs, and a diversion weir on the Matsoku River are under construction (Fig. 2). Completion of these components is scheduled for 2003. Further project phases will involve the construction of additional large dams on the lower reaches of the Senqu River, together with a series of pumping plants and interconnecting water conveyance tunnels. If all phases would be completed in 2020, the scheme would transfer over 70 m^3 of water every second to South Africa and the total cost is expected to exceed U.S. $ 8 billion. However, the viability of the forthcoming phases will be reconsidered as growing concern about the serious economical, social and ecological effects has been expressed by various actors, including the World Bank.

The LHWP is managed by the *L*esotho *H*ighlands *D*evelopment *A*uthority (LHDA), which is responsible for resettlement and compensation issues, environmental protection, and overall construction management. In an effort to prevent the permanent impoverishment of displaced people, the governments of South Africa and Lesotho promised that affected people will be assisted to maintain a standard of living which is not inferior to that obtained at the time of first disturbance (LHDA 1990). Critics of the controversial highland-lowland project, mostly by non-governmental organizations, point to a number of unsolved problems. These include the loss of arable or grazing land and the involuntary resettlement of a large number of people. Formerly remote mountain communities are still faced with dramatic changes in livelihood conditions, combined with insufficient and delayed compensation. Evidence suggests that standards of living for the majority of project-af-

Fig. 3 Katse Reservoir is located in the Lesotho Highlands. Sophisticated technology of dam construction and surrounding infrastructure contrast vividly to the traditional settlement and land use patterns (Photo: NÜSSER, July 2002).
Der Katse-Stausee liegt im Hochland von Lesotho. Hoch entwickelte Technologie im Bereich des Staudammbaus und umgebende Infrastruktureinrichtungen bilden einen starken Kontrast zu traditionellen Siedlungs- und Landnutzungsmustern (Foto: NÜSSER, Juli 2002).

Fig. 4 With a height of 185 m and a crest length of 710 m, the Katse Dam is the highest dam in Africa and one of the most spectacular arch structures of its type in the world (Photo: NÜSSER, September 2000).
Mit einer Höhe von 185 m und einer Kronenlänge von 710 m bildet der Katse-Damm den höchsten Damm Afrikas und eine der weltweit spektakulärsten Bogenstrukturen dieses Dammtyps (Foto: NÜSSER, September 2000).

fected people are in fact declining. Meanwhile, few affected people have been able to re-establish livelihoods, and many displaced people have been resettled without access to safe drinking water and other basic resources (GLEICK 1998). Despite explicit requirements implemented in the recent World Bank policy, resettled people received no compensation prior to their displacement. The loss of natural resources such as grazing land, fuel wood and thatch grasses was not adequately compensated. Such concerns have led to large protests over the large dams in Lesotho. The realisation of the aforementioned additional phases is thus bound to be contentious.

4. Conclusions and perspectives

To meet the challenge of understanding the complexity of the large dams debate, it is necessary to focus on the different development perspectives of the main advocates and opponents of dam-building. The actor-orientated approach of political ecology provides a framework to identify the character and scope of the controversy between bureaucratic state agencies and technocratic engineering companies on the one hand and environmental, non-governmental activist groups and adversely affected people on the other. Whether or not to construct a dam requires careful consideration and balancing of costs and benefits. Dam-planning implies adequate information, transparency and intense debate by the affected people and the general public. The guidelines and criteria of the *W*orld *C*ommission on *D*ams (WCD) propagate equity, efficiency, accountability, sustainability and participatory decision-making. In weighting, WCD postulates that governments should give the same significance to social and environmental aspects as to technical, economic and financial factors. It also calls for negotiations in which all stakeholders should have equal opportunities to influence decisions from the beginning of the planning process. Whether or not the economic benefits provided by increased generation of electricity or improved water supply justify environmental impacts and social costs of dam-building, ultimately remains a political decision. The policy of the World Bank towards specific large dams (e. g. withdraw funding for Sardar Sarovar in 1993) demonstrates their flexible response strategy because of increasing public pressure.

The case study of the Lesotho Highlands Water Project demonstrates prominent economic and political inequities between states. The LHWP has brought water revenues, hydro-electric power and major infrastructure to Lesotho, and water to Gauteng in South Africa. While the benefits to South Africa are clear, the mountain people of Lesotho have lost arable and grazing land. Many remote mountain communities have experienced drastic negative changes in livelihood conditions. Adequate compensation and appropriate subsistence strategies for displaced people are largely absent. Evaluating the project against the guidelines and criteria of the World Commission on Dams provides a negative result. Therefore, the completion of projected phases in the future remains contentious, mainly due to the envisaged political and social conflicts.

References

BLAIKIE, P. (1995): Changing Environments or Changing Views? A Political Ecology for Developing Countries. Geography, **80**: 203–214.

BLAIKIE, P. (1999): A Review of Political Ecology: Issues, Epistemology and Analytical Narratives. Zeitschrift für Wirtschaftsgeographie, **43** (3/4): 131–147.

BRYANT, R. L. (1999): A Political Ecology for Developing Countries? Progress and Paradox in the Evolution of a Research Field. Zeitschrift für Wirtschaftsgeographie, **43** (3/4): 148–157.

BRYANT, R. L., & S. BAILEY (1997): Third World Political Ecology. London, New York.

CHAO, B. F. (1995): Anthropological Impact on Global Geodynamics due to Water Impoundment in Major Reservoirs. Geophysical Research Letters, **22**: 3533– 3536.

DORCEY, T., STEINER, A., ACREMAN, M., & B. ORLANDO [Eds.] (1997): Large Dams: Learning from the Past, Looking at the Future. Workshop Proceedings. IUCN, Gland, Cambridge, and the World Bank Group, Washington, D. C.

FEARNSIDE, P. (1988): China's Three Gorges Dam: Fatal Project or Step Toward Modernization. World Development, **16** (5): 615–630.

GADGIL, M., & R. GUHA (1994): Ecological Conflicts and the Environmental Movement in India. Development and Change, **25**: 101–136.

GLEICK, P. H. (1998): The World's Water 1998–1999. The Biannual Report on Freshwater Resources. Washington.

GOLDSMITH, E., & N. HILDYARD (1984): The Social and Environmental Impacts of Large Dams. Vol. 1. Cornwall.

HORTA, K. (1995): The Mountain Kingdom's White Oil. The Lesotho Highlands Water Project. The Ecologist, **25** (6): 227–231.

International Commission on Large Dams (1998): World Register of Dams. Paris.

Lesotho Government (1994): Map of Lesotho. 1 : 250 000. Maseru.

LHDA (1990): Lesotho Highlands Water Project. Environmental Action Plan. London, Maseru.

LHDA (1995): Lesotho Highlands Water Project. 1 : 300 000. Maseru.

MAFAKANE, M. (1999): Lesotho Roads Network. In: CHAKELA, Q. K. [Ed.]: State of the Environment in Lesotho 1997. Maseru: 97–104.

Manibeli Declaration (1994): Call for a Moratorium on World Bank Funding of Large Dams. Annexed in: MCCULLY, P. (1996): Silenced Rivers: The Ecology and Politics of Large Dams. London, New Jersey: 316–320.

MCCULLY, P. (1996): Silenced Rivers: The Ecology and Politics of Large Dams. London, New Jersey.

McCully, P. (2001): Silenced Rivers: The Ecology and Politics of Large Dams. Enlarged and Updated Edition. London, New Jersey.
Morse, B., & T. Berger (1992): Sardar Sarovar: The Report of the Independent Review. Ottawa.
Nel, E., & P. Illgner (2001): Tapping Lesotho's "White Gold": Inter-Basin Water Transfer in Southern Africa. Geography, **86** (2): 163–167.
Nüsser, M. (2001): Ressourcennutzung und externe Eingriffe im peripheren Gebirgsland Lesotho. Geographische Rundschau, **53** (12): 30–36.
Öktem, K. (2002): When Dams are Build on Shaky Grounds. Policy Choice and Social Performance of Hydro-Project Based Development in Turkey. Erdkunde, **56**: 310–325.
Orrego, J. P. (1997): In Defence of the BioBio River. In: Usher, A. D. [Ed.]: Dams as Aid. A Political Anatomy of Nordic Development. London, New York: 153–170.
Petts, G. E. (1984): Impounded Rivers: Perspectives for Ecological Management. Chichester.
Scudder, T. (1997): Social Impacts of Large Dam Projects. In: Dorcey, T., Steiner, A., Acreman, M., & B. Orlando [Eds.]: Large Dams: Learning from the Past, Looking at the Future. Workshop Proceedings. IUCN, Gland, Cambridge, and the World Bank Group, Washington, DC.: 41–68.
Sears, J., & K. Bragg (1987): Bio-Bio: A River under Threat. The Ecologist, **17** (1): 15–20.
World Bank (1996): World Bank Lending for Large Dams: A Preliminary Review of Impacts. Operations Evaluation Department, Précis 125. Washington, D. C.
World Commission on Dams (2000): Dams and Development. A New Framework for Decision-Making. London, Sterling.

Manuskriptannahme: 11. November 2002

Dr. Marcus Nüsser, Universität Bonn, Geographisches Institut, Meckenheimer Allee 166, 53115 Bonn
E-Mail: m.nuesser@uni-bonn.de