

Baghel, R. and Nüsser, M. 2010. Discussing large dams in Asia after the World Commission on Dams: Is a political ecology approach the way forward? *Water Alternatives* 3(2): 231-248



---

## Discussing Large Dams in Asia after the World Commission on Dams: Is a Political Ecology Approach the Way Forward?

### Ravi Baghel

Graduate Programme of Transcultural Studies, Cluster of Excellence: Asia & Europe, University of Heidelberg, Heidelberg, Germany; baghel.ravi@gmail.com

### Marcus Nüsser

Chair, Department of Geography, Director South Asia Institute, South Asia Institute, University of Heidelberg, Heidelberg, Germany; marcus.nuesser@uni-heidelberg.de

---

**ABSTRACT:** The guidelines proposed in the World Commission on Dams (WCD) final report were vehemently rejected by several Asian governments, and dam building has continued apace in most Asian countries. This reaction is in line with the simplistic dam debate, where dam critics offer laundry lists of socioeconomic and environmental costs, and dam proponents highlight the benefits while underestimating associated costs. Whereas the WCD sought to evaluate dams in terms of 'costs and benefits', this approach is self-defeating due to the very subjectivity of such measurements. This paper argues that the way ahead must be to move beyond a consensus evaluation of dams, and instead examine the shifting asymmetries and discursive flows that sustain and promote dam building over time. However, such an analysis of the dam discourse must incorporate an understanding of the multiple actors and driving forces, as well as the underlying power relations within this politicised environment. We therefore suggest that a post-structural political ecology approach provides a suitable framework for the future examination of large dams in Asia.

**KEYWORDS:** World Commission on Dams, political ecology, Anthropocene, large dams, post-structural political ecology

---

### INTRODUCTION

Of the over 45,000 large dams<sup>1</sup> inventoried by the World Commission on Dams (WCD) in 2000, most existed in Asia, with China and India being two of the three most prolific dam building countries in the world. Large dams have evoked controversial discussions about development paths, effectiveness, environmental consequences and social justice (McCully, 2001). After decolonisation, widespread construction of large dams started in the countries of the South. Such gigantic technological hydroscares<sup>2</sup> continue to symbolise human dominance over nature, lauded as they are as icons of modernity and national prestige, although they often generate massive resistance from adversely affected people and NGOs. The WCD was created to find common ground between all stakeholders in

---

<sup>1</sup> The International Commission on Large Dams (ICOLD) has defined 'large dams' as dams that are more than 15 m in height or have a storage capacity of more than 3 million cubic metres.

<sup>2</sup> We prefer to use the term technological 'hydroscares' over the broader term 'waterscares' to avoid privileging water as the central lens through which to view large dams. Large dams are in addition products of 'hydrocracies' (Molle et al., 2009), as well as material outcomes of global cultural flows, especially those of technology and ideology, which Appadurai described as *technoscares* and *ideoscares* (Appadurai, 1996). The complicated nature of large dams, in that they are artificial, material, ideological, cultural, political and social all at once, leads us to label them hydroscares, to distinguish them from hybrid 'water landscapes' or waterscares (Swyngedouw, 1999).

the negotiation process, and agreed upon five guiding principles: justice, sustainability, efficiency, participation and accountability. However, ten years later, the controversy has continued. The current debate on CO<sub>2</sub> reduction through hydropower revitalises the global discussion of large dams, by positioning them as so-called 'green' alternatives.

The WCD process illustrates the pitfalls in attempting to come to a consensus evaluation of large dams. The global impact of large dams in economic, social and ecological terms, however, is of a magnitude that makes the necessity of engaging in the large dams debate ever more urgent. We propose that political ecology can serve as the analytical framework necessary for identifying and explaining some of the limitations of the WCD in addressing the dams debate. An awareness of these limitations can in turn lead to approaches that have greater potential to achieve the WCD's goals of equity and justice.

In the first part of the article, we develop our theoretical framework by situating the issue of large dams within the broader context of the Anthropocene (Crutzen and Stoermer, 2000; Ehlers, 2008; Zalasiewicz et al., 2008). This is followed by a short discussion of political ecology, following which we go on to describe the notion of politicised environments (Bryant and Bailey, 1997; Bryant, 1998). This section explains why the analysis of the ecological impact of humanity necessitates a wider inclusion of political, social and economic aspects. The next section of the article traces the shifts in the discourse and meaning of large dams, as the idea spread across the world. This section highlights the contingent and contradictory meanings of large dams and points to the various ideas associated with them such as modernisation, development and social engineering. The section that follows describes the administrative simplification of rivers into manageable technological hydroscaapes, thereby ignoring their properties and functions as complex fluvial environments. This is followed by recounting the WCD's processes, its role in the dam debate and in its aftermath. We conclude this article with our remarks on the potential benefits of deploying post-structural political ecology as a theoretical intervention.

## **POLITICISED ENVIRONMENTS IN THE ANTHROPOCENE**

The human impact on Earth's systems is now so large that it has been suggested that the current geological epoch be renamed from 'Holocene' to 'Anthropocene'<sup>3</sup> (Crutzen and Stoermer, 2000; Ehlers, 2008; Zalasiewicz et al., 2008). More than half (172 out of 292) of all large river systems have been fragmented by human dam building, with the more than 45,000 large dams worldwide obstructing two-thirds of all freshwater flows, and with reservoirs capable of holding back more than 15% of the annual global river runoff (Nilsson and Berggren, 2000; Meybeck, 2003; Nilsson et al., 2005). Apart from affecting freshwater flows, large dams also prevent sediment from being carried to the sea – more than half (53%) of the sediments from regulated river basins are trapped by dams. If unregulated basins are included, this means that 25-30% of sediments worldwide are intercepted by large dams (Vörösmarty et al., 2003). This drastic alteration of the world's river systems has received much less attention than global climate change, yet it has been suggested that "the global impact of direct human intervention in the terrestrial water cycle (through land cover change, urbanization, industrialization, and water resources development) is likely to surpass that of recent or anticipated climate change, at least over decadal time scales" (Meybeck and Vörösmarty, 2004; Vörösmarty et al., 2004).

All organisms modify their environment to some degree, but humans have taken it to a new level, whereby many ecosystems are dominated directly by humanity and no ecosystem on Earth's surface is

---

<sup>3</sup> The term 'Anthropocene' was coined as an analogy from the present geological epoch, the *Holocene*; with *anthropo*-indicating human, and *-cene* indicating new. The Anthropocene is variously considered as beginning with the Industrial Revolution (ca 1800), or with the beginning of agriculture (8000 years ago). Even with pessimistic estimates of the future of humanity, existing anthropogenic effects on Earth systems such as changes in sedimentation patterns in river systems and changes in the composition of the atmosphere are likely to have effects for the next 50,000 years (Crutzen and Stoermer, 2000).

free from pervasive human influence. This means that most ecological structures and functions – even up to planetary scale – cannot be understood without accounting for the strong, and often dominant, influence of humans (Vitousek et al., 1997). Any such understanding of human influence necessarily needs to take into account the special attributes of humanity, such as iniquitous power relations and the processes of meaning creation, that manifest themselves in human-environmental interactions. Political ecology as an approach is a promising way of understanding the connectedness of planetary-level changes with human social, political, cultural and economic practices on all scales.

According to the classic definition by Blaikie and Brookfield, political ecology "combines the concerns of ecology and a broadly defined political economy" (1987). However, the understanding of political ecology has changed considerably since then (Peet and Watts, 1996a, 2004; Bryant, 1998, 1999; Forsyth, 2003, 2008; Blaikie, 2008). Biersack (2006) describes a 'first-generation' political ecology that dates to the first Marxist use of the term 'political ecology' by Wolf (1972). Its key characteristics were a theoretical commitment to neo-Marxist positions, especially world systems theory and dependency theory. One of the key insights of this early political ecology was that local ecological changes needed to be understood in the context of global relations of power. There was an emphasis on how incorporation into global capitalism led to increasing pressure on local 'land managers' to produce surpluses, leading them to extract 'surpluses' from the environment and thereby degrading their local ecologies (Blaikie, 1985; Blaikie and Brookfield, 1987). However, this first-generation political ecology continued to rely on an essential nature, external and separate from humans, in its search for structural solutions.

Escobar (2010) describes the succeeding 'second-generation' political ecology that arose from the various currents of post-Marxism, postmodernism, post-colonialism and post-structuralism.<sup>4</sup> According to him, what distinguishes this generation from the preceding is "its engagement with the epistemological debates fostered by the theoretical positions known as constructivism and anti-essentialism". One of the most significant changes in the field was the resulting shift in focus away from finding underlying political and economic 'structures' reproduced as environmental change. Post-structural political ecologies attempt to understand how the unequal power relations amongst social groups, and the 'knowledge' that mediates human-environmental interactions, are reproduced as present-day ecological changes on all scales.

While it has been suggested that a third-generation post-constructivist political ecology is in the making (Escobar, 2010), we believe that it is premature to apply this to the context of large dams. Conversely, there has certainly over the last few years been a move to make political ecology more relevant in solving real-world problems, while still retaining its critical edge (Bryant and Goodman, 2004; Robbins, 2004; Walker, 2006, 2007; Blaikie, 2008; Forsyth, 2008; Robbins and Monroe Bishop, 2008). Robbins (2004) described the roles of political ecology as being that of a "hatchet" in its use as critique, and also that of a "seed" through its commitment to equitable and sustainable solutions to environmental problems. Both these roles are not only appropriate in the case of the large dams debate, but also complementary. As we discuss later, one of the major limitations of the WCD was the lack of critique of the *idea* of large dams, as opposed to an evaluation of their functioning. We therefore propose that an analytical framework built upon post-structural political ecology can form the basis for understanding the connectedness of the social, economic, political and ecological impacts of large dams. This analysis can then extend the understanding of the meanings and discourses of large dams, rather than seeing them as self-evident.

Further, when the ecological effects of large dams are considered in the context of Anthropocene changes to the world's river systems, it also quickly becomes apparent that "if one is to take ecology seriously then states as artificial, and frequently arbitrary demarcations of territorial entities, are not a

---

<sup>4</sup> We use the term 'post-structural political ecology' hereafter, as it is the broadest description that subsumes a number of strands of political ecologies, while giving adequate attention to the main difference with early political ecology, namely the move away from purely structural explanations.

useful starting place" (Dalby, 2004). Whereas it was progressive in terms of global environmental politics, the WCD was reliant on the international legal framework based on the state system, which was sadly inadequate for the task of understanding ecological change on multiple scales and distinct dimensions. On the other hand, this is complicated by the fact that the symbolic aspects of large dams are closely connected to these very arbitrary territorial entities of nation states. This dilemma can, to some extent, be addressed by directing the 'hatchet' or critical attention of political ecology towards the central role of the state in the construction of large dams in Asia. The solution-oriented or 'seed' aspect can then focus on a multitude of scales, varied both spatially and temporally (see Sneddon, 2002; Sneddon et al., 2002; Sneddon and Fox, 2006).

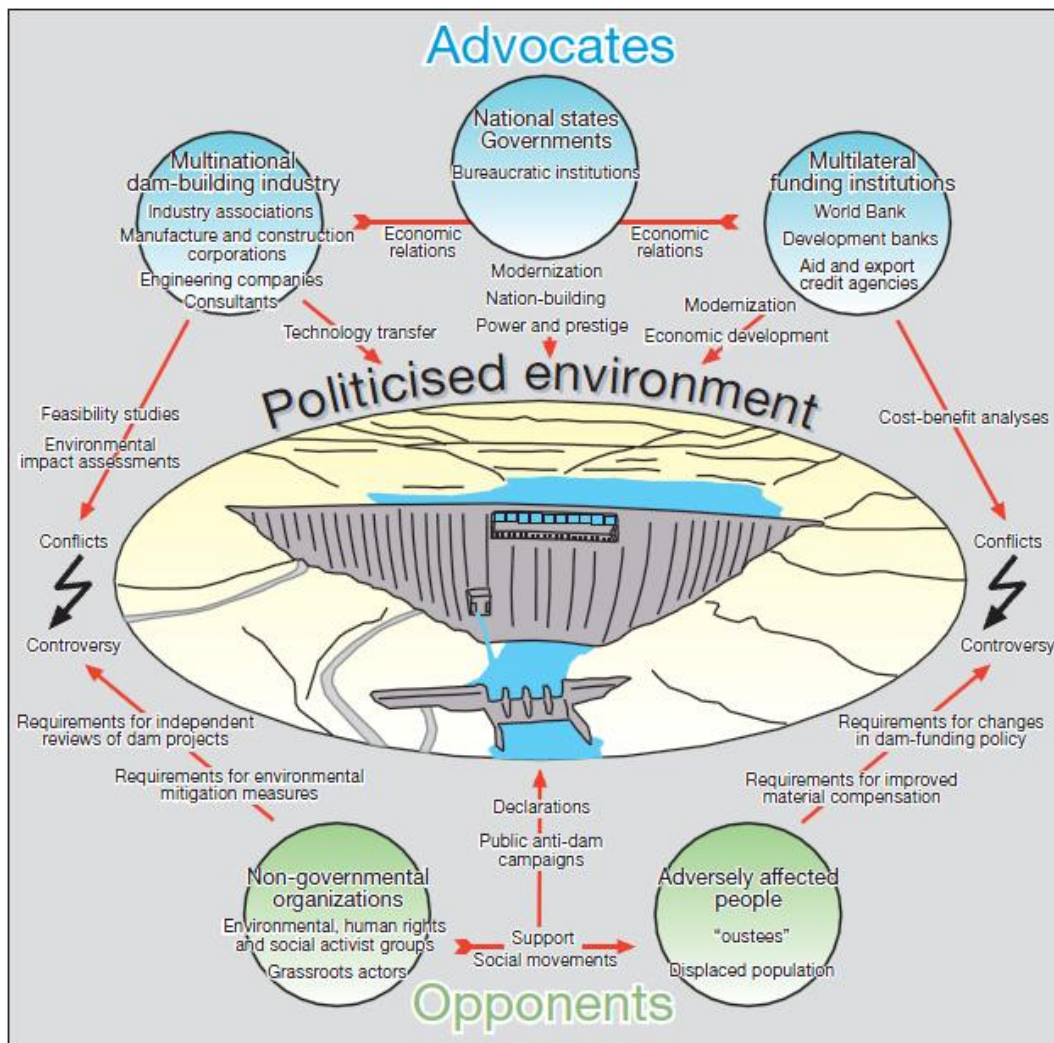
Another major consideration for any approach applied to the large dams debate is its efficacy in analysing the dimensions of environmental conflicts, especially those occurring in Asia, where a large number of dams continue to be built and have generated intense conflict. In the context of conflicts over large dams, this implies that the deep-seated differences between various interest groups cannot be simplified as modernised hydro politics versus environmental fundamentalism. Analysing the conflicts and development models associated with dam construction using an actor-orientated approach of political ecology seems more appropriate (Blaikie, 1995, 1999; Bryant and Bailey, 1997; Bryant, 1999). The controversy between advocates and opponents of large dams takes place in a politicised environment (figure 1).

This actor-oriented model (figure 1) visualises a typical conflict constellation in the large dams debate. Furthermore, it emphasises the multiple forms of power and knowledge relations within such a conflict, and the asymmetries inherent in these relations. This can be seen, for example, in the various forms of expert knowledge, such as feasibility studies and environmental impact assessments (EIAs), and in the public declarations, pamphlets, press releases, etc. that are deployed to as countermeasures. Similarly, asymmetric power relations are apparent in the case of lending institutions, recipient states and dam-affected people. This constellation is not case-specific, but a general model of the various actors and their strategies in conflicts over large dams, in the context of a "politicised environment".

Central to the concept of a 'politicised environment' (Bryant and Bailey, 1997) is the recognition that environmental problems and various dimensions of environmental conflicts cannot be understood in isolation from the political and economic contexts 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 phases, and to reinforce their perspective. However, the positions of these actors are derived not only from their political and economic interests, but also from the symbolic and cultural aspects of both rivers and dams.

The next section explores the spread of the idea of dam building and the different meanings associated with dams. This is intended to highlight the political and value laden nature of dams, and to draw attention to the shifting and contingent discourse of dam building that has led to them being associated with modernisation, development and social engineering.

Figure 1. Large dams as a politicised environment: Asymmetries of knowledge and power (Nüsser, 2003).



**DAMS: A HISTORY OF FLOWS**

Despite the long history of water management in human civilisation by means of dams and reservoirs, the 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 era of large dams began in the interwar period, with the damming of rivers in southern USA and the construction of the Hoover dam on the Colorado river, which was considered at the time of its completion in 1936 to be the largest man-made structure in the world, with the amount of masonry exceeding that used in the Great Pyramid of Giza (Bureau of Reclamation, 2005). Dams have since continued to be symbols of modernisation, national prestige and of human dominance over nature (McCully, 2001). In addition, large dams have been central elements in the so-called 'hydraulic mission' of using up every drop of water for the benefit of mankind, and have given rise to elaborate hydraulic bureaucracies (Molle, 2009; Molle et al., 2009).

A turning point in the history of large dams was the formation of the Tennessee Valley Authority (TVA). This was the first time that the idea of regulating the entire river basin through a series of multipurpose dams had been put into practice, although the ambition to achieve total control of the

hydrological regime at the river basin level has a longer history (Molle, 2009). It is important to understand that the TVA was not merely a river valley project; it came with an entire vision to not just subdue the 'river as nature', but also to transform human nature. Its first Chairman, Arthur E. Morgan, saw the TVA as "little less than a means of reinventing civilization". The TVA project included elements of social engineering through the setting up of model townships for workmen like Norris, the setting up of 'progressive' schools and the promotion of ideal, prosperous communities. These views appear to have been widely held, and a similar Promethean zeal is also apparent in other contemporary accounts:

This [war against the waste of soil fertility, land and water in the valley] is our 'hundred years' war', a struggle against nature, including our own human nature, magnified by a vast geographical design to a scale which dwarfs the other river civilizations of the world. The creation of the Tennessee Valley Authority in 1933 – in itself the most ambitious political and economic pioneering since the construction of the Great Wall of China – is only the first stage of a process which must continue for a century, until we have conquered the Great Valley for our uses or destroyed it (Franklin, 1939).

Three-quarters of a century later, with the benefit of hindsight, it is apparent that the TVA moment marked a shift in the discourse on large dams – from being mere local engineering artefacts, to becoming key elements of a national solution for transforming an entire peripheral region. These initial ideas of integrated river basin planning, the transformation of nature and an inherent social purpose associated with the TVA were also spread as part of the TVA vision.

The early years of the TVA were filled with infighting among the directors and uncertainty regarding its continued operation (Hargrove, 1994; Klingensmith, 1998). This was resolved, though, as the Chairman of the board of directors, A. E. Morgan was fired, and David Lilienthal replaced him. The romanticisation of the TVA dates from this period and especially to Lilienthal's attempts to counter various kinds of opposition from private power companies and conservative politicians, as well as the legal threat of the TVA act being ruled unconstitutional. The lobbying efforts of Lilienthal to garner support for the TVA saw their apotheosis in his book *TVA: Democracy on the March*. This book sought to present the TVA as an example of 'grassroots democracy', so that policy decisions made at the central government level were implemented at grassroots autonomously by the TVA, thus achieving the best of both worlds through the centralisation of policy and decentralisation of implementation.

The close connection between the New Deal and the TVA enabled it to weather domestic political opposition, and also helped it become a part of the post-war idea of 'development'. The idea that the TVA was not only successful, but also successfully replicable was propagated by Lilienthal himself:

I write of the Tennessee Valley, but all this could have happened in almost any of a thousand other valleys where rivers run from the hills to the sea... [I]n China and in India there are just such rivers... rivers that in the violence of flood menace the land and the people, then sulk in idleness and drought – rivers all over the world waiting to be controlled by men – the Yangtze, the Ganges, the Ob, the Parana, the Amazon, the Nile (Lilienthal, 1944).

By 1953, more than 39 million people from across the world had visited the TVA, and David Lilienthal's book had been translated into 14 languages (Jones and Freeman, 2000). The number of professional visitors from South Asia, especially from India and Pakistan, was particularly large and contributed to the diffusion both in terms of technology and ideas (Wescoat et al., 1992; Wescoat et al., 2000).

The TVA model was enthusiastically promoted as a cure for 'backwardness', and the vision was spread all over the world (Cullather, 2002; Ekbladh, 2002), some early examples being the Damodar Valley Corporation (DVC) in India (Goodall, 1945) and the Yangtze Valley Authority (YVA) in China. The DVC was never fully realised as planned (Klingensmith, 1998), while the YVA was abandoned with the coming of the communist government in China. However, it can be argued that the YVA project, the original vision of which can be traced back to Sun Yat-Sen, was indeed eventually realised as the even more grandiose Three Gorges Project (Jones and Freeman, 2000).

The allure of large dams was felt across the political spectrum, with communist guerrillas in both India and China enthusiastically approving of them (Rao, 1978) and the US seeing these projects as a bulwark against communism. During the 1950s, under the 'socialist' government of Nehru, newly independent India was building a large number of dams. When there was a financial crunch, US diplomatic circles were quite concerned regarding the possible failure of the projects and tried to arrange aid for India to cover the shortfall. The success of projects like the DVC and the iconic Bhakra Nangal project (famously described by Prime Minister Nehru as "a new temple of resurgent India... the symbol of India's progress") was seen by US policy makers as essential to preventing India "falling to the communists" (Chaudhry and Vanduzer-Snow, 2008).

This brief sketch of the changing imagination of dams is not intended to provide a comprehensive overview; for instance, there is no mention of the Soviet influence on dam building here. Any detailed examination of the discursive history of dams would necessarily be beyond the scope of this paper. Even so, this brief description is, however, enough to highlight the contingent and socio-politically constructed nature of dams. The move from individual dams to planning at the river valley level is by no means intuitive. The spread of the TVA as a model was vitally dependent on the 'myth'<sup>5</sup> that had been fashioned out of the messy reality – out of the TVA's attempts to pre-empt various political, legal and financial threats, and its compulsion to create constituencies that would garner it public legitimacy.

However, this does not imply that this 'varnished' TVA vision was unquestioningly accepted and put into practice by its various adherents; the vision was usually modified to suit local needs. The story is, as Klingensmith (1998) so ably demonstrated, one of appropriation, and one where the TVA was a point of departure, rather than one of direct imitation. Additionally, the TVA model consisted not only of technical and social dimensions, but also demonstrated the necessity, in most cases, of achieving public legitimacy,<sup>6</sup> as well as the possible means of achieving it.

### **'DENATURED' RIVERS: THE TRANSFORMATION OF FLUVIAL ENVIRONMENTS**

The spread of large dams to the new nation states of Asia was not merely due to the popularity of the TVA model, or a simple flow of technology from more advanced to backward countries. The appeal of dams rose from a then widespread ideological phenomenon that Scott has called 'high modernism', meaning:

A strong, one might even say muscle-bound, version of the self-confidence about scientific and technical progress, the expansion of production, the growing satisfaction of human needs, the mastery of nature (including human nature), and above all, the rational design of social order commensurate with the scientific understanding of natural laws (Scott, 1999).

In addition, a key aspect of this 'high modernism' was that it was dependent upon state planning, and most of the finances for these projects also came from the state. Further, this ideology was broadly popular across the political spectrum, among the elite. The very people like state planners, engineers, bureaucrats and political leaders, who were most susceptible to the high modernist ideology, were also the ones responsible for dam building across Asia. Although dams were only one category of projects in the high modernist portfolio, the possibility for building larger projects like new cities (like Brasilia or New Delhi) was limited due to scale, and smaller projects lacked the allure of large dams.

Quite apart from the hubris of the developmental high-modernist state, what added to the recklessness with which dams were built was the practice of the state of creating 'legibility'. Scott

<sup>5</sup> Here the use of 'myth' is after Hargrove (1994): "A myth is not a fiction but a set of missions and aspirations that guide an organization and give it legitimacy with the rest of society".

<sup>6</sup> This is not merely a preoccupation of democratic countries, and a regime like the Communist Party of China (CPC) has proven to be exquisitely sensitive to public criticism of large dams. The difference between political systems lies more in the *means* of achieving or retaining public legitimacy (e.g. banning critical books, sidelining dissenters or jailing them), although other elements like the close connection between large dams and national purpose are surprisingly similar.

(1999) describes how the advance of scientific forestry in Germany was rooted in an attempt to gain a clear picture of the volume of timber that could be extracted sustainably and reliably per year from any given forest. This abstraction of the forest into a volume of timber meant that non-timber forest produce became devalued and imperceptible. The various forest species used as forage, medicinal herbs and firewood became irrelevant to the *Forstwissenschaftler* (forester); indeed, the varied uses of the timber species themselves dwindled into the background. Linton (2008, 2010) has described how the hydrologic cycle was readily adapted by state planning agencies for this purpose of making water legible, in order to account for and control it. Furthermore he also describes the ease with which large dams were seen to fit into this picture of a universal hydrologic cycle as elements necessary to ensure controlled, even-flowing rivers.

Similarly, the story of rivers in countries such as India and China is one where, as a result of the practice of administrative legibility, rivers became mere flows of water for the high-modernist state. An interesting outcome of this 'denaturing' of rivers into moving water bodies is that of the recurring complaint of 'water running waste to the sea', used by varied personages such as Stalin and the Supreme Court of India.<sup>7</sup> This 'denaturing' is required for administration, which then in turn leads to an attempt to measure, control and regulate this flow of water. The complex ecological interconnections and the nature of fluvial environments are reduced beyond recognition in this administrative simplification – rivers become a clearly demarcated watercourse, with clear boundaries, while fluvial landscapes lose their temporary nature and become marked on cadastral maps (D'Souza, 2006, 2008). As a result of this administrative reordering, only the administrative aspects of the river remain visible, namely flood control, irrigation, power and navigation. This process of administrative simplification sets the stage for transforming complex fluvial environments into simplified and manageable technological hydroscares, first discursively, and eventually in practice. This process has been aided by an increasing reliance on 'experts' to administer nature, which is in itself seen as an important element of modernity (Mitchell, 2000, 2002).

A former minister and bureaucrat closely associated with dams and river planning in India illustrated the dangers of 'legibility' perfectly (and perhaps unintentionally) in a newspaper column:

The small mistake [in dam planning] lay in the details, in which the Devil resides. The mistake was not what the activists said. (They were all wet. If your hydrology is good and your aquifer modelling is good, which this was, you could make mincemeat of their quibbling. It doesn't matter for they don't look at reason, but that is another argument. Any reasonable person would be convinced). The problem lay elsewhere. The modelling was so good that we very accurately used up all the water for the crops, the trees and for drinking. We all forgot the obvious. Rivers also need water (Alagh, 2009).

The luxury of forgetting something that will have effects for generations to come is not one available to many. The above statement also highlights the inequality and power relations inherent in decision making regarding dams; typically, the people most affected have the least say. Additionally, even the 'activists' critical of these projects are peremptorily dismissed as lacking reason. It was in such a situation that the WCD sought to intervene by trying to come to an accurate consensus on large dams, by including all stakeholders in the debate.

---

<sup>7</sup> See Molle (2006, Note 17) for a detailed discussion of similar statements made by leaders across the world, dating as far back as the 12th century. A speculative explanation for this phenomenon is that the level of abstraction required by the state's attempts to make the landscape legible and governable (Scott, 1999; Linton, 2008, 2010) mean that the only vision available to the leaders is that of water moving waste to the sea. On the other hand, for someone interacting with it as part of their everyday life world, the river is often deeply implicated in their livelihoods and everyday social and cultural practices, which makes it nearly impossible for them to conceive of it as merely water flowing to the sea.



## THE WCD PROCESS

The controversy over large dams had become increasingly intense by the 1990s, and their image had lost the lustre of the TVA days. In 1995, the new President of the World Bank, James Wolfensohn, announced his intention to undertake a review of the development effectiveness of large dams. Consequently, a review of large dams was undertaken by the independent Operations Evaluation Department of the World Bank. The first-stage internal review of 50 World Bank-assisted large dams found that, whereas 90% of the dams met the standards applicable at the time of approval, only 26% were acceptable against the standards applicable in 1996. However, the review also concluded that mitigation of the adverse social and environmental consequences of large dams would have been both feasible and economically justified in 74% of the cases (Dorcey, 1997).

At the same time as this internal revaluation of large dams took place, the World Bank was facing increasing external opposition to the projects it was assisting; most notably against the Sardar Sarovar project on the Narmada river in India. At this time the IUCN-World Conservation Union sought to create an institutional partnership with the World Bank and involve various stakeholders in consultations to break this stalemate. The key recommendation of this process was to create a World Commission on Dams; with the objective to review the development effectiveness of large dams and to develop standards, criteria and guidelines to inform future decision making (Brinkerhoff, 2002).

The WCD process was remarkably inclusive, with twelve commissioners coming from government, industry, academia, NGOs and social movements. The commission was also praised for its inclusiveness, transparency and independence (Dingwerth, 2005), while the WCD model was regarded widely as a unique experiment in global public policymaking (Srinivas, 2001; Bandyopadhyay, 2002; Bandyopadhyay et al., 2002; Brinkerhoff, 2002; Dubash et al., 2002; Dubash, 2009). The WCD report lay down the five key principles for decision making: equity, efficiency, participatory decision making, sustainability and accountability, as mentioned earlier. The commission also worked on creating an extensive 'knowledge base' on large dams. The work programme for the knowledge base comprised eight case studies; three country studies; seventeen thematic reviews on social, ecological, economic, financial and institutional aspects of large dams; four regional consultations – in Colombo, São Paulo, Cairo and Hanoi; and a cross-check survey that included quantitative data on 125 dams. In addition, the WCD accepted 947 submissions from individuals and institutions (WCD, 2000).

At the end of a 2½-year consultative process, the WCD produced its final report *Dams and Development: A New Framework For Decision-Making*. The report consisted of two parts – the first summarised the findings of the various studies and the second part, 'The way forward', contained "internationally acceptable criteria and standards", as well as 26 guidelines for future dam projects. The report had the consensus of all twelve commissioners, which was a major achievement considering the at times fractious process of commissioner selection and the diverse interest groups they represented. The consensus among such a diverse group shows that "the Commission did transcend, rather than reproduce, fractures among interest groups in the dams debate" (Dubash et al., 2002).

This consensus among the commissioners, however, did not extend to the stakeholders in the dam debate. The reception of the WCD report was varied. Civil society groups generally welcomed both the findings and the recommendations for the future, while, conversely, the World Bank, dam industry organisations and the governments of China and India had reactions ranging from lukewarm to positively hostile. To take the example of the World Bank, at the launch of the WCD report in November 2000, the bank's president, Wolfensohn, stated that he would consult its shareholders regarding the WCD recommendations. In March 2001, the bank stated that it would not "comprehensively adopt the 26 WCD guidelines", but would use them as a reference point when considering investments in dams. However, in the Water Resources Sector Strategy (WRSS) of the same year, the World Bank argued for a 'high-risk, high-reward' strategy that generally lowered the existing standards for economic, social and environmental performance. This prompted the twelve WCD commissioners to write in a letter to Wolfensohn on 12 July 2002:

Given that a major thrust of the WRSS is to recommend that the Bank actively re-engage in financing large-scale dams (referred to in the WRSS as high-reward/high-risk hydraulic infrastructure), we think that it is unwise to dismiss without justification or explanation the recommendations of the first-ever global review of dams reached through consensus and developed through an extensive participatory process with support from the World Bank (in Bello and Guttal, 2006).

Although the future recommendations of the WCD were praised by many civil society actors, they were criticised in equal measure for being inapplicable, contradictory and not deriving from the studies in the first part of the report. It was suggested that this may have been due to the short time available for the completion of the study, as well as perception gaps between stakeholders. According to these critics the commission had failed to come with practical and applicable guidelines, and following the guidelines would make dam building impossible (Fujikura and Nakayama, 2003, 2009; Nakayama and Fujikura, 2006). In addition, the WCD was also attacked for being 'anti-development', overstepping its terms of reference and indulging in 'politics':

[C]onsider the oft-repeated terms such as: civil society; human rights; development debate; models of development; water as an instrument for peace; planning process; participatory and inclusive approach; transparency; equity; governance; political corruption; arrogance of bureaucrat-technocrat-politician nexus; and so on... Did the [terms of reference] not encourage the reader to expect the report to tell him why and how to go about making 'better dams' to avail of nature's bounty, if not tame its fury, rather than telling him almost to forget about dam building (Thatte, 2001)?

The controversy over the 'political' aspect of the WCD report can be traced back partly to the commission's view that the technical information about dams already resided with professional dam associations, such as the International Commission on Large Dams (ICOLD) and the International Hydropower Association (IHA). Therefore, WCD members decided to focus on "those key issues around which there is greatest disagreement" (Dubash et al., 2002).

Whereas critics decried their lack of scientific credibility, it was their very political commitment that made these guidelines progressive in terms of social and environmental justice. The WCD was expected to resolve a long-running and global controversy through evolving a consensus among stakeholders, as well as policy guidelines that would derive their legitimacy from democratic consultation. The commission did a commendable job in fulfilling its strategic objectives of achieving a consensus and democratic legitimacy. Nevertheless, the impact on institutional policies was negligible. The WCD set an example for global public policymaking and of achieving democratic legitimacy through public participation; this did not, however, translate into significant institutional change in most cases. The biggest contribution of the WCD to the large dams debate was that it uncovered the deeply political and subjective nature of dam building; it dispelled any illusions that it was a purely technical and apolitical exercise.

## CONCLUSIONS AND OUTLOOK

The article has pointed to the shifting discourses and diverse meanings associated with dams, which are seen not merely as technological artefacts, but in administrative parlance are associated with powers to transform development, remove backwardness and make a state modern. The WCD focused on the material effects of large dams, whereas inadequate attention was given to the discourses that lead to their legitimisation. The consequences of this lack of attention are apparent when some of the responses most critical of the WCD report are considered. The response by the Ministry of Water Resources, Government of India, for instance, is illustrative of this point:

The references relating to India in the report are not based on factual and authentic information... The guidelines for development now suggested by the WCD in their final report are wholly incompatible with our development imperatives. Having made impressive strides since independence in developing our water

resources, India proposes to continue with its programme of dam construction (...) to ensure continued self-sufficiency in food grain production and to meet the energy and drinking water needs of a growing population (Sekhar, 2001).

The close connection between development and dams, and the deeply held beliefs in their efficacy in solving a multitude of problems, are discernible in this response. In a sense, it is indeed impossible for a country to have development without dams, as both are part of the same discourse (Escobar, 1995). The iconic Bhakra-Nangal project<sup>8</sup> in India, mentioned previously, has often been cited as incontrovertible evidence of the effectiveness of large dams. Indeed, if Bhakra is examined using the WCD's rationalistic approach of evaluating direct costs and benefits, then the project's performance has been above average. The people displaced cooperated with the government regarding resettlement, and more than half a century later 93% of the originally displaced people have received some form of resettlement (Narain, 2005). On the benefits side there has been an increase in the irrigated area, and the project's command area has seen an increase in food production. However, if we take a political ecology approach and see the Bhakra project not as an isolated technological artefact but as a node in the intersection of flows of capital, ideologies, politics, technologies, knowledge and, of course, water (Swyngedouw, 1999), a considerably different picture emerges.

A three-year study of Bhakra led by Shripad Dharmadhikary (2005) traces the history of Bhakra to inter-state water disputes between unified Punjab and Sind in British India. As the upper riparian province, the Punjab government used the plans for constructing a storage dam on the Sutlej river at Bhakra as a bargaining chip to establish its greater need for irrigation as compared to the lower riparian Sind. These disputes continued after the division of Punjab between India and Pakistan. The Indian government impounded the flows of Sutlej and Ravi into Pakistan in April 1948, drying up the canals in (Pakistani) West Punjab. Although India claimed this was done due to the lapse of an agreement on maintaining river flows, it was widely believed that this action was revenge against the Pakistani-backed invasion of Kashmir (Guha, 2008). This was soon followed by the beginning of work on Bhakra, and the ensuing protests by Pakistan resulted in arbitration by the World Bank. This, in 1960, resulted in the Indus Waters Treaty, giving India exclusive use of the Sutlej, Ravi and Beas rivers; Pakistan was granted the use of the Indus, Jhelum and Chenab rivers. The building of Bhakra also strengthened India's negotiating position on the use of Sutlej waters, as otherwise Pakistan would have gotten a much larger share of the river waters, based on historical use. However, as Dharmadhikary points out, the construction of Bhakra did not add any new area under irrigation, but merely shifted the irrigation from one set of areas (mostly in Pakistan) to another. This implies that, unless one takes a position sanctifying artificial nation state boundaries (e.g. Rangachari, 2005), Bhakra's contribution to irrigation is questionable.

The notion of 'scarcity', which is often one of the key arguments used to support large dams, has been questioned both in broader philosophical terms (Xenos, 1989) and specifically with regard to water (Mehta, 2003, 2007; Iyer, 2004; Budds, 2008). However, in the case of the Bhakra command area, even the scarcity argument was clearly untenable due to already existing irrigation infrastructure in the form of canals. The increased irrigation only became fully available from 1970 onward, when restrictions on the Indian use of Sutlej waters were lifted under the Indus Waters Treaty. While this increased irrigation intensity was not necessary for agriculture, as had been practiced earlier, the greater availability of canal water fulfilled one of the essential conditions for the use of High Yielding Variety (HYV) seeds for agriculture. This is the reason why Bhakra is often credited with ushering in the Green Revolution.

The Bhakra irrigation system follows a *warabandi* principle, which is based on strictly rotational water supplies of canal waters proportional to land holdings. However, a study by Sakthivadivel et al. (1999) found that instead of equitable water supply per unit of command area, 70% of the areas with

---

<sup>8</sup> The Bhakra-Nangal project consists of the 225 m high Bhakra dam on the Sutlej river, while 13 kms downstream is the 29 m high Nangal barrage. The project includes two power stations and canals. It is hereafter referred to as 'Bhakra'.

good quality groundwater consistently received low canal water supply, whereas only 9% of areas with saline or poor quality groundwater received low canal water supply. This suggests that far from the claims of canal waters recharging groundwater, which is then used for irrigation (Bhatia et al., 2007), canal waters are used to *supplement* groundwater irrigation in areas with good quality groundwater, and in areas with poor groundwater quality canal waters are used as a substitute. The unsustainability of such an irrigation regime is borne out by the phenomenon of deep and falling water tables in areas with fresh groundwater and rising water tables in areas with problems of salinity and waterlogging.

The easy availability of canal waters and cheap (at times free) electricity for pumping groundwater were necessary inputs, but were not by themselves sufficient for the Green Revolution. In addition, high quantities of fertilizers, pesticides, mechanisation and the *timely* availability of water were necessary. The high cost of these inputs was defrayed partly by government subsidies on fertilizers, electricity and tubewells, cheap institutional credit for the mechanisation of agriculture and minimum support prices for the purchase of food grains. This regime led to a decrease in crop diversification (Singh and Sidhu, 2004), with the share of cropped area under cereals rising from 45% in 1960-61 to 78% in 2000-01 (Gill, 2005). This loss of diversification had the unintended effect of reducing room for manoeuvre for farmers, and they became locked into a spiral of increasing costs of inputs, with stagnant or declining returns. The financial returns per hectare cultivated declined by 2.18% per annum for wheat and rice through the 1990s, and in the case of cotton, by as much as 14.24% per annum (Ghuman, 2008).

The prevalence of indebtedness amongst farmers in the region is high, with farmers in Punjab having the highest outstanding liabilities compared to other states of India (NSSO, 2005). The majority of this borrowing is for operational farming expenses, and more than half of it is obtained from non-institutional sources, which usually attracts extremely high interest rates. Farmers get trapped in the spiral of increasing input costs, increased borrowing and repayment of interest, into further degrading the environment. Using a political ecology approach, it becomes clear that farmers (land managers) are forced to keep producing a surplus and end up extracting this surplus from the environment, thus degrading it. It is difficult to pin down the exact contribution of irrigation to the agricultural and socioeconomic changes in the area; however, a controlled study of two villages in the region, one irrigated by the Bhakra canal and the other non-irrigated, found high levels of agricultural intensification in the first, and greater economic diversification and non-agricultural skills in the second (Groenfeldt, 1984). This result hints at the role of Bhakra as an important step in a developmental path, which has led to the present-day crisis of agriculture in Punjab and Haryana, with the associated high ecological and social costs. The problems associated with the development path epitomised by Bhakra have become increasingly obvious to farmers in Punjab. Now there are civil society efforts like the Kheti Virasat Mission (KVM) to reverse some of the damage to the environment by reverting to traditional agricultural practices that do not require intensive irrigation and high cost inputs (Grewal, 2008).

In the light of the Bhakra example, the Indian government response to the WCD is based more on the unchallenged 'myth' of large dams, rather than a comprehensive and careful evaluation of their performance. This does not mean that the beliefs underlying dam building can be dismissed; on the contrary, they are a vital component of the dams debate. Future discussions on large dams must therefore dissect the beliefs and meanings associated with dams as much as their economic, social and political aspects. This scrutiny is essential, not to distinguish 'true' beliefs from 'false' ones, but rather to identify how and why certain narratives acquire their certainty and legitimise or reinforce existing inequalities.

The WCD process was mostly focused on an examination of the *effects* of large dams, yet an examination of their *causes* is just as important. With the use of a political ecology approach, the economic and political inequalities reproduced as environmental change, as in large dam projects, can be scrutinised. However, a limited political ecology approach may fail to uncover the discursive and symbolic role of dams. A more classical political ecology may tend toward a highly structural explanation that emphasises power relations and economic factors, but it is important to point out that human-environmental interactions are mediated by knowledge. Therefore, an investigation of the

process of knowledge construction and underlying discourses needs to be integrated into any understanding of ecological change (Escobar, 1996; Peet and Watts, 1996b, 2004; Bryant, 1998). This is why we believe a *post-structural* political ecology may help uncover the role of not only asymmetric power relations, but also that of asymmetric knowledge relations.

Political ecology remains a research field in development, and it does not have prescribed research methods or an overarching coherent set of key theories. The diversity of perspectives and backgrounds of political ecology practitioners is, however, strength in itself and opens entry points from which varied stakeholders can participate. The element of political commitment/activism that is an intrinsic part of political ecology provides an excellent arena for academic practitioners and activists to work together; something that is especially relevant in the context of a highly charged and politicised discussion of large dams. The collaboration in knowledge production by activists of the MAB (*Movimento dos Atingidos por Barragens*, the Movement of Dam-Affected People) and Brazilian academics documented by McCormick (2009) is an excellent example of the possibilities of such cooperation.

There is also a considerable body of existing research, of direct relevance to a political ecology approach to large dams, which can be divided broadly into three major sets. The first category derives from the long tradition of hazards research, especially work related to the framing of floods and drought, which can be used to analyse the legitimisation of large dams as infrastructure necessary to prevent natural disasters (Blaikie et al., 1994). An example of such work in South Asia, influenced by the seminal contribution of Gilbert White to hazards research in the USA, is that of Daanish Mustafa (1998, 2002a, 2002b, 2007; Mustafa and Wescoat, 1997; Wescoat et al., 2000). Especially interesting in the context of large dams is his notion of "hazardscape", which builds upon insights from hazards research (especially pragmatism), political ecology and 'socio-nature' (Mustafa, 2005).

The 'socio-nature', or social nature tradition, has given rise to the second set of work that can make contributions to the dams debate (Budds, 2004, 2008). The notion of a socially constructed nature builds upon the idea that there is no nature separate and external to man, and all nature is known only through social and discursive practices (Swyngedouw, 2004, 2009; Kaika, 2006). This notion does not negate the materiality of non-human natural entities like rivers, but it does deny the possibility of knowledge of such entities that can transcend human social practices to separate the material from the discursive. One of the most important elements of this tradition is the notion of a dialectically produced socio-nature, as opposed to natural resources that are contested over by humans (Robbins, 2004). This implies further that natural entities like rivers are not to be seen as inert objects, but as having agency on their own. This insight is something sorely missing from the deliberations of the WCD.

A third set of relevant research draws upon the insights drawn from Michel Foucault's work on governmentality and knowledge/power (Foucault, 2007) as applied to the environment. This literature has been variously called eco-governmentality, green governmentality and environmentality (Luke, 1995a, 1995b, 1996, 1999; Darier, 1999; Rutherford, 2007). This literature examines the role of institutions, which through the use of 'expert knowledge' construct an 'environment' that can then receive various forms of management and intervention – all in the interest of governing its constituents. Typical of this is the work of Michael Goldman (2001a, 2001b, 2005, 2007) that examined the role of the World Bank in producing environmental knowledge and how this was related to its interventions in the hydropolitics of the Mekong region.

These three sets of research are not completely distinct from each other, and practitioners usually do not restrict themselves to selecting them singly. This categorisation is intended to highlight the multiple perspectives that are possible (and necessary) with respect to discussing the phenomenon of large dams. What is common to these approaches is a dialectical view of human-environmental interactions, an attention to multiple scales, a critical approach to practices of knowledge creation and a commitment to find equitable, place-based solutions to environmental issues. When seen in the context of the Anthropocene and planetary scale changes caused by dams, it becomes more important than ever to have analysis across a variety of scales, both temporal and spatial (Sneddon, 2002; Sneddon et al., 2002). Political ecology as a field is not novel, and neither is post-structuralism;

however, the reason why political ecology is suggested as an approach for the future study of large dams is because it shares the normative concerns of equity and justice implicit in the WCD's recommendations, while offering the possibility of avoiding many of its limitations.

The WCD process was a milestone in terms of establishing a non-hierarchical framework for the discussion of a global phenomenon. The commission started its discussion without any fixed notions about dams and demonstrated the benefits of engaging with a diversity of opinions in a mutually respectful manner. A post-structural political ecology can build upon the strengths of this process, while at the same time addressing many of the blind spots of the WCD process. An understanding of the political, economic and knowledge relations thus acquired can form the basis for a meaningful discussion of large dams and point the way towards necessary change.

## ACKNOWLEDGEMENTS

This paper reflects on central concepts of the research project "Large dams: contested environments between hydro-power and resistance" carried out in the framework of the Cluster of Excellence "Asia & Europe in a Global Context: Shifting Asymmetries in Cultural Flows" at the University of Heidelberg. The authors are grateful for the associated financial and intellectual support, and would also like to thank two anonymous reviewers whose comments significantly improved the paper.

## REFERENCES

- Alagh, Y.K. 2009. Drained of all sense. *Indian Express*, May 2, editorial [www.indianexpress.com/news/drained-of-all-sense/468356/0](http://www.indianexpress.com/news/drained-of-all-sense/468356/0) (accessed 21 June 2009)
- Appadurai, A. 1996. *Modernity at large: Cultural dimensions of globalization*. Minneapolis: University of Minnesota Press.
- Bandyopadhyay, J. 2002. A critical look at the report of the World Commission on Dams in the context of the debate on large dams on the Himalayan rivers. *International Journal of Water Resources Development* 18(1): 127-145.
- Bandyopadhyay, J.; Mallik, B.; Mandal, M. and Perveen, S. 2002. Dams and development: Report on a policy dialogue. *Economic and Political Weekly* 37(40): 4108-4112.
- Bello, W. and Guttal, S. 2006. The limits of reform: The Wolfensohn era at the World Bank. *Race Class* 47(3): 68-81.
- Bhatia, R.; Malik, R.P.S. and Bhatia, M. 2007. Direct and indirect economic impacts of the Bhakra multipurpose dam, India. *Irrigation and Drainage* 56(2-3): 195-206.
- Biersack, A. 2006. Reimagining political ecology: Culture/power/history/nature. In Biersack, A. and Greenberg, J.B. (Eds), *Reimagining political ecology*, pp. 3-42. Durham and London: Duke University Press.
- Blaikie, P. 1985. *The political economy of soil erosion in developing countries*. London and New York: Longman.
- Blaikie, P. 1995. Changing environments or changing views? A political ecology for developing countries. *Geography* 80(3): 203-214.
- Blaikie, P. 1999. A review of political ecology: Issues, epistemology and analytical narratives. *Zeitschrift für Wirtschaftsgeographie* 43(3/4): 131-147.
- Blaikie, P. 2008. Epilogue: Towards a future for political ecology that works. *Geoforum* 39(2): 765-772.
- Blaikie, P. and Brookfield, H. 1987. *Land degradation and society*. London: Methuen.
- Blaikie, P.; Cannon, T.; Davis, I. and Wisner, B. 1994. *At risk: Natural hazards, people's vulnerability, and disasters*. London and New York: Routledge.
- Brinkerhoff, J.M. 2002. Global public policy, partnership, and the case of the World Commission on Dams. *Public Administration Review* 62(3): 324-336.
- Bryant, R. 1998. Power, knowledge and political ecology in the third world: A review. *Progress in Physical Geography* 22(1): 79-94.
- Bryant, R. 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. and Bailey, S. 1997. *Third World political ecology*. New York: Routledge.

- Bryant, R. and Goodman, M. 2004. Consuming narratives: The political ecology of 'alternative' consumption. *Transactions of the Institute of British Geographers* 29(3): 344-366.
- Budds, J. 2004. Power, nature and neoliberalism: The political ecology of water in Chile. *Singapore Journal of Tropical Geography* 25(3): 322-342.
- Budds, J. 2008. Whose scarcity? The hydrosocial cycle and the changing waterscape of La Ligua river basin, Chile. In Goodman, M.; Boykoff, M. and Evered, K. (Eds), *Contentious geographies: Environmental knowledge, meaning, scale*, pp. 59-78. Aldershot: Ashgate.
- Chaudhry, P. and Vanduzer-Snow, M. (Eds). 2008. *The United States and India: A history through archives. The formative years*. Thousand Oaks: Sage.
- Crutzen, P.J. and Stoermer, E.F. 2000. The "Anthropocene". *IGBP Newsletter* 41: 17-18.
- Cullather, N. 2002. Damming Afghanistan: Modernization in a buffer state. *The Journal of American History* 89(2): 512-537.
- Dalby, S. 2004. Anthropocene ethics: Rethinking 'the political' after environment. Paper presented at the International Studies Association (ISA) annual convention, March 2004, Montreal. <http://http-server.carleton.ca/~sdalby/papers/DalbyISA2004.pdf> (accessed 6 November 2009)
- Darier, E. 1999. Foucault and the environment: An introduction. In Darier, E. (Ed), *Discourses of the environment*, pp. 1-33. Oxford and Malden: Blackwell.
- Dharmadhikary, S. 2005. *Unravelling Bhakra: Assessing the temple of resurgent India*. Badwani, India: Manthan Adhyayana Kendra.
- Dingwerth, K. 2005. The democratic legitimacy of public-private rule making: What can we learn from the World Commission on Dams. *Global Governance* 11(1): 65-83.
- Dorcey, A.H.J. (Ed). 1997. *Large dams: Learning from the past, looking at the future. Workshop proceedings, Gland, Switzerland, April 11-12, 1997*, Washington, DC: IUCN World Conservation Union and the World Bank Group.
- D'Souza, R. 2006. *Drowned and dammed: Colonial capitalism and flood control in Eastern India*. New Delhi: Oxford University Press.
- D'Souza, R. 2008. Framing India's hydraulic crisis: The politics of the modern large dam. *Monthly Review* 60(3), [www.monthlyreview.org/080811dsouza.php](http://www.monthlyreview.org/080811dsouza.php)
- Dubash, N.K. 2009. Global norms through global deliberation- Reflections on the World Commission on Dams. *Global Governance* 15(2): 219-238.
- Dubash, N.K.; Dupar, M.; Kothari, S. and Lissu, T. 2002. A watershed in global governance? An independent assessment of the World Commission on Dams (Executive Summary). *Politics and the Life Sciences* 21(1): 42-62.
- Ehlers, E. 2008. *Das Anthropozän: Die Erde im Zeitalter des Menschen*. Darmstadt: Wissenschaftliche Buchgesellschaft.
- Ekbladh, D. 2002. "Mr. TVA": Grass-roots development, David Lilienthal, and the rise and fall of the Tennessee Valley Authority as a symbol for U.S. overseas development, 1933-1973. *Diplomatic History* 26(3): 335-374.
- Escobar, A. 1995. *Encountering development: The making and unmaking of the Third World*. Princeton: Princeton University Press.
- Escobar, A. 1996. Construction nature: Elements for a post-structuralist political ecology. *Futures* 28(4): 325-343.
- Escobar, A. 2010. Postconstructivist political ecologies. In Redclift, M. and Woodgate, G. (Eds), *The international handbook of environmental sociology*, pp. 91-105. Cheltenham: Edward Elgar.
- Forsyth, T. 2003. *Critical political ecology: The politics of environmental science*. New York: Routledge.
- Forsyth, T. 2008. Political ecology and the epistemology of social justice. *Geoforum* 39(2): 756-764.
- Foucault, M. 2007. *Security, territory, population: Lectures at the Collège de France, 1977-78*. Basingstoke and New York: Palgrave Macmillan
- Franklin, J. 1939. *The future is ours*. New York: Modern Age.
- Fujikura, R. and Nakayama, M. 2003. Perception gaps among stakeholders regarding the WCD guidelines. *International Environmental Agreements: Politics, Law and Economics* 3(1): 43-57.
- Fujikura, R. and Nakayama, M. 2009. Lessons learned from the World Commission on Dams. *International Environmental Agreements: Politics, Law and Economics* 9(2): 173-190.
- Ghuman, R.S. 2008. Socio-economic crisis in rural Punjab. *Economic and Political Weekly* 43(7): 12-15.
- Gill, S. 2005. Economic distress and farmer suicides in rural Punjab. *Journal of Punjab Studies* 12(2): 219-237.
- Goldman, M, 2001a. Constructing an environmental state: Eco-Governmentality and other transnational practices of a 'Green' World Bank. *Social Problems* 48(4): 499-523.

- Goldman, M. 2001b. The birth of a discipline: Producing authoritative green knowledge, World Bank-style. *Ethnography* 2(2): 191-217.
- Goldman, M. 2005. *Imperial nature: the World Bank and struggles for social justice in the age of globalization*. New Haven and London: Yale University Press.
- Goldman, M. 2007. How "Water for All!" policy became hegemonic: The power of the World Bank and its transnational policy networks. *Geoforum* 38(5): 786-800.
- Goodall, M.R. 1945. River valley planning in India: The Damodar. *The Journal of Land and Public Utility Economics* 21(4): 371-375.
- Grewal, M. 2008. Natural-born farmers. *Indian Express*, 4 January 2008.
- Groenfeldt, D. 1984. Change persistence and the impact of irrigation: A controlled comparison of two North Indian villages. PhD Thesis. University of Arizona, Tucson, USA.
- Guha, R. 2008. *India after Gandhi: The history of the world's largest democracy*, Indian edition. Noida: Picador.
- Hargrove, E. 1994. *Prisoners of myth: The leadership of the Tennessee Valley Authority, 1933-1990*. Princeton: Princeton University Press.
- Iyer, R.R. 2004. *Water: Towards a transformation. A critique and a declaration*. New Delhi: Centre for Policy Research.
- Jones, W.C. and Freeman, M. 2000. Three Gorges dam: The TVA on the Yangtze river. *21st Century Science and Technology* 13(3): 24-46.
- Kaika, M. 2006. Dams as symbols of modernization: The urbanization of nature between geographical imagination and materiality. *Annals of the Association of American Geographers* 96(2): 276-301.
- Klingensmith, D. 1998. "One valley and a thousand": Remaking America, India and the world in the image of the Tennessee Valley Authority, 1945-1970. PhD thesis. University of Chicago, Chicago, USA.
- Lilienthal, D.E. 1944. *TVA: democracy on the march*. New York: Overseas Editions.
- Linton, J. 2008. Is the hydrologic cycle sustainable? A historical-geographical critique of a modern concept. *Annals of the Association of American Geographers* 98(3): 630-649.
- Linton, J. 2010. *What is water? The history of a modern abstraction*. Vancouver: University of British Columbia Press.
- Luke, T.W. 1995a. On environmentalism: Geo-power and eco-knowledge in the discourses of contemporary environmentalism. *Cultural Critique* (31): 57-81.
- Luke, T.W. 1995b. Sustainable development as a power/knowledge system: The problem of governmentality. In Fischer, F. and Black, M. (Eds) *Greening environmental policy: The politics of a sustainable future*, pp. 21-32. London: Paul Chapman
- Luke, T.W. 1996. Generating green governmentality: A cultural critique of Environmental Studies as a power/knowledge formation. Unpublished manuscript. [www.cddc.vt.edu/tim/tims/Tim514a.PDF](http://www.cddc.vt.edu/tim/tims/Tim514a.PDF) (accessed 7 October 2009)
- Luke, T.W. 1999. Environmentalism as green governmentality. In Darier, E. (Ed), *Discourses of the Environment*, pp. 121-51. Oxford and Malden: Blackwell
- McCormick, S. 2009. *Mobilizing science: Movements, participation, and the remaking of knowledge*. Philadelphia: Temple University Press.
- McCully, P. 2001. *Silenced rivers: The ecology and politics of large dams*. Enlarged and updated. London and New York: Zed Books.
- Mehta, L. 2003. Contexts and constructions of water scarcity. *Economic and Political Weekly* 38(48): 5066-5072.
- Mehta, L. 2007. Whose scarcity? Whose property? The case of water in western India. *Land Use Policy* 24(4): 654-663.
- Meybeck, M. 2003. Global analysis of river systems: from Earth system controls to Anthropocene syndromes. *Philosophical Transactions of the Royal Society B: Biological Sciences* 358(1440): 1935-1955.
- Meybeck, M. and Vörösmarty, C.J. 2004. The integrity of river and drainage basin systems: Challenges from environmental change. In Kabat, P. (Ed), *Vegetation, water, humans and the climate: A new perspective on an interactive system*, pp. 297-479. New York: Springer-Verlag.
- Mitchell, T. (Ed). 2000. *Questions of modernity*. Minneapolis and London: University of Minnesota Press.
- Mitchell, T. 2002. *Rule of experts: Egypt, techno-politics, modernity*. Berkeley and Los Angeles: University of California Press.
- Molle, F. 2006. Planning and managing water resources at the river basin level: Emergence and evolution of a concept. Colombo, Sri Lanka: IWMI. [www.iwmi.cgiar.org/Assessment/Publications/research\\_reports.htm](http://www.iwmi.cgiar.org/Assessment/Publications/research_reports.htm) (accessed 3 October 2009)



- Molle, F. 2009. River-basin planning and management: The social life of a concept. *Geoforum* 40(3): 484-494.
- Molle, F.; Mollinga, P. and Wester, P. 2009. Hydraulic bureaucracies and the hydraulic mission: Flows of water, flows of power. *Water Alternatives* 2(3): 328-349.
- Mustafa, D. 1998. Structural causes of vulnerability to flood hazard in Pakistan. *Economic Geography* 74(3): 289-305.
- Mustafa, D. 2002a. To each according to his power? Participation, access, and vulnerability in irrigation and flood management in Pakistan. *Environment and Planning D: Society and Space* 20(6): 737-752.
- Mustafa, D. 2002b. Linking access and vulnerability: Perceptions of irrigation and flood management in Pakistan. *The Professional Geographer* 54(1): 94-105.
- Mustafa, D. 2005. The production of an urban hazardscape in Pakistan: Modernity, vulnerability, and the range of choice. *Annals of the Association of American Geographers* 95(3): 566-586.
- Mustafa, D. 2007. Social construction of hydropolitics: The geographical scales of water and security in the Indus basin. *Geographical Review* 97(4): 484-501.
- Mustafa, D. and Wescoat, J. 1997. Development of flood hazards policy in the Indus river basin of Pakistan, 1947-1996. *Water International* 22(4): 238-244.
- Nakayama, M. and Fujikura, R. 2006. Issues in World Commission on Dams report development: Inconsistencies between the facts found and the guidelines. *Hydrological Processes* 20(6): 1263-1272.
- Narrain, S. 2005. Bhakra dam – A different view. *Frontline* 22(12): 1.  
[www.thehindu.com/fline/fl2212/stories/20050617000507700.htm](http://www.thehindu.com/fline/fl2212/stories/20050617000507700.htm)
- Nilsson, C. and Berggren, K. 2000. Alterations of riparian ecosystems caused by river regulation. *Bioscience* 50(9): 783-792.
- Nilsson, C.; Reidy, C.A.; Dynesius, M. and Revenga, C. 2005. Fragmentation and flow regulation of the world's large river systems. *Science* 308(5720): 405-408.
- NSSO (National Sample Survey Organisation). 2005. *Situation assessment survey of farmers: Indebtedness of farmer households*. New Delhi: Ministry of Statistics and Programme Implementation, Government of India.  
[http://planningcommission.gov.in/sectors/agri\\_html/Indebtedness%20of%20farmer%20household%2059%20round%202003.pdf](http://planningcommission.gov.in/sectors/agri_html/Indebtedness%20of%20farmer%20household%2059%20round%202003.pdf)
- Nüsser, M. 2003. Political ecology of large dams: A critical review. *Petermanns Geographische Mitteilungen* 147(1): 20-27.
- Peet, R. and Watts, M. (Eds). 1996a. *Liberation ecologies: Environment, development, social movements*. London and New York: Routledge.
- Peet, R. and Watts, M. 1996b. Liberation ecology: Development, sustainability, and environment in an age of market triumphalism. In Peet, R. and Watts, M. (Eds), *Liberation ecologies: Environment, development, social movements*, pp. 1-45. London and New York: Routledge.
- Peet, R. and Watts, M. (Eds). 2004. *Liberation ecologies: Environment, development, social movements*. 2nd edition. London and New York: Routledge.
- Rangachari, R. 2005. *A critique on 'Unravelling Bhakra'*. Working Paper No. 19. New Delhi: Centre for Policy Research.
- Rao, K.L. 1978. *Cusecs candidate: Memoirs of an engineer*. New Delhi: Metropolitan.
- Robbins, P. 2004. *Political ecology: A critical introduction*. Malden, Oxford and Victoria: Blackwell.
- Robbins, P. and Monroe Bishop, K. 2008. There and back again: Epiphany, disillusionment, and rediscovery in political ecology. *Geoforum* 39(2): 747-755.
- Rutherford, S. 2007. Green governmentality: Insights and opportunities in the study of nature's rule. *Progress in Human Geography* 31(3): 291-307.
- Sakthivadivel, R.; Thiruvengadachari, S.; Amerasinghe, U.; Bastaanssen, W.G.M. and Molden, D. 1999. *Performance evaluation of the Bhakra irrigation system, India, using remote sensing and GIS techniques*. Research Report No. 28. Colombo, Sri Lanka: International Water Management Institute.
- Scott, J.C. 1999. *Seeing like a State: How certain schemes to improve the human condition have failed*. New Haven and London: Yale University Press.
- Sekhar, A. 2001. Government of India, Ministry of Water Resources, response to Dams and Development – A new framework for decision-making. Letter from Ministry of Water Resources, Government of India to the World Commission on Dams. February 1. [www.unep.org/dams/documents/default.asp?documentid=501](http://www.unep.org/dams/documents/default.asp?documentid=501) (accessed 24 June 2009)
- Singh, J. and Sidhu, R.S. 2004. Factors in declining crop diversification: Case study of Punjab. *Economic and Political Weekly* 39(52): 5607-5610.

- Sneddon, C. 2002. Water conflicts and river basins: The contradictions of co-management and scale in Northeast Thailand. *Society and Natural Resources* 15(8): 725-741.
- Sneddon, C. and Fox, C. 2006. Rethinking transboundary waters: A critical hydropolitics of the Mekong basin. *Political Geography* 25(2): 181-202.
- Sneddon, C.; Harris L.; Dimitrov, R. and Özesmi, U. 2002. Contested waters: Conflict, scale, and sustainability in aquatic socioecological systems. *Society and Natural Resources* 15(8): 663-675.
- Srinivas, R.K. 2001. Demystifying dams and development: The World Commission on Dams and development. *Environmental Politics* 10(3): 134-138.
- Swyngedouw, E. 1999. Modernity and hybridity: Nature, regeneracionismo, and the production of the Spanish waterscape, 1890-1930. *Annals of the Association of American Geographers* 89(3): 443-465.
- Swyngedouw, E. 2004. *Social power and the urbanization of water: Flows of power*. New York: Oxford University Press.
- Swyngedouw, E. 2009. The political economy and political ecology of the hydro-social cycle. *Journal of Contemporary Water Research & Education* 142(1): 56-60.
- Thatte, C.D. 2001. Aftermath, overview and an appraisal of past events leading to some of the imbalances in the report of the World Commission on Dams. *International Journal of Water Resources Development* 17(3): 343-351.
- Vitousek, P.M.; Mooney, H.A.; Lubchenco, J. and Melillo, J.M. 1997. Human domination of Earth's ecosystems. *Science* 277(5325): 494.
- Vörösmarty, C.J.; Meybeck, M.; Fekete, B.; Sharma, K.; Green, P. and Syvitski, J.P.M. 2003. Anthropogenic sediment retention: Major global impact from registered river impoundments. *Global and Planetary Change* 39(1-2): 169-190.
- Vörösmarty, C.J. ; Lettenmaier, D.; Leveque, C.; Meybeck, M. ; Pahl-Wostl, C.; Alcamo, J.; Cosgrove, W.; Grassl, H.; Hoff, H.; Kabat, F.; Lansigan, F.; Lawford, R. and Naiman, R. 2004. Humans transforming the global water system. *Eos* 85(48): 509-520.
- Walker, P.A. 2006. Political ecology: Where is the policy? *Progress in Human Geography* 30(3): 382.
- Walker, P.A. 2007. Political ecology: Where is the politics? *Progress in Human Geography* 31(3): 363.
- Wescoat, J.; Halvorson, S. and Mustafa, D. 2000. Water management in the Indus basin of Pakistan: A half-century perspective. *International Journal of Water Resources Development* 16(3): 391-406.
- Wescoat, J.; Smith, R. and Schaad, D. 1992. Visits to the US Bureau of Reclamation from South Asia and the Middle East, 1946-1990: An indicator of changing international programs and politics. *Irrigation and Drainage Systems* 6(1): 55-67.
- Wolf, E. 1972. Ownership and political ecology. *Anthropological Quarterly* 45(3): 201-205.
- World Commission on Dams. 2000. *Dams and development: A new framework for decision-making. The report of the World Commission on Dams*. London: Earthscan.
- Xenos, N. 1989. *Scarcity and modernity*. London and New York: Routledge.
- Zalasiewicz, J; Williams, M.; Smith, A.; Barry, T.L.; Coe, A.L.; Bown, P.R.; Brenchley, P.; Cantrill, D.; Gale, A.; Gibbard, P.; Gregory, F.J.; Hounslow, M.W.; Kerr, A.C.; Pearson, P.; Knox, R.; Powell, J.; Waters, C.; Marshall, J.; Oates, M.; Rawson, P.; and Stone, P. 2008. Are we now living in the Anthropocene? *GSA Today* 18(2): 4-8.