Chapter 2
Misplaced Knowledge: Large Dams as an Anatopism in South Asia

Ravi Baghel

Abstract Even though South Asia accounts for a large proportion of the dams in the world, they have seldom been examined at the subcontinental scale, with most scrutiny confined to specific projects. Large dams are not merely functional technologies but come invested with a broad range of meanings. Using a Geography of Science approach, this chapter attempts to create a genealogy of the evolution of the meaning of dams and identify the ways in which they have been influenced by the spaces in which this technology developed. Going beyond a simplistic local-global opposition, I argue that large dams are technological attempts to recreate the landscape in the image of other idealised spaces. In many ways, this recreation is fundamentally at odds with local conditions and makes large dams an anatopism in South Asia.

Keywords Large dams • Tropicality • Hydraulic mission • Genealogy • South Asia

2.1 Introduction

South Asia accounts for a substantial proportion of the large dams identified by the World Commission on Dams (WCD 2000), with recent figures showing that India alone has 4,711 large dams with another 390 under construction (CWC 2009). Whereas the ecological effects of large dams have been studied frequently within the context of individual projects, or at the scale of river basins, their suitability at the subcontinental scale of South Asia has not received adequate scrutiny. This

R. Baghel, M.A. (✉)
Department of Geography, South Asia Institute, Heidelberg University,
Im Neuenheimer Feld 330, 69120 Heidelberg, Germany
e-mail: baghel@uni-heidelberg.de

M. Nüsser (ed.), *Large Dams in Asia*, Advances in Asian Human-Environmental Research, DOI 10.1007/978-94-007-2798-4_2,

mismatch with the broader environmental setting has been explored at times by activists, as well as by some experts like Kapil Bhattacharjee (Nandy 2001). For the most part, however, critics of large dams have instead focused their attention on the socioecological consequences of *specific* projects. This meant that proponents of large dams have had no need to defend large dams as a technological or even rational choice, with the objections remaining confined to ethical and economic ones.

It is essential to analyse large dams not as mere technological artefacts but as massive infrastructure with social, historical and cultural dimensions, deeply implicated in human relations with the environment. This is necessary in order to come up with a much more general critique of our relation with this technology, rather than with a simple evaluation in terms of cost-benefit, or ecological impact. Secondly, broadly considered, large dams are not simply about generating electricity or aiding in irrigation but have many symbolic aspects in addition to their functional ones. When seen in terms of our relation with the environment, this technology is based on the intention to transform the landscape, to make it more productive, more suitable for human progress. This might appear to be self-evident and too obvious to be noted, but it is this very property, hiding in plain sight, that deserves critical examination. In assessing large dams in terms of human relations of meaning with the landscape, this chapter complements other contributions in this volume that emphasise the role of dams in our social and political relations and in examining the asymmetric relations between expert knowledge and local knowledge that become apparent through exercises aimed at promoting public participation in Environmental Impact Assessments (Choudhury, Chap. 6, this volume; D'Souza, Chap. 4, this volume).

Though the temporal concept of anachronism, something that belongs to a different time, is relatively familiar, its geographic counterpart is lesser known. Anatopism is the analogical idea of objects that are 'out of place', or appear to belong to another space. I argue that dams are such an anatopism in South Asia and are flawed attempts to recreate an ideal river whose conception is derived from elsewhere. This examination proceeds with the premise that the technology of large dams is neither objective nor universal and is inflected with the spatial and historical contexts through which it has evolved. By focusing on what large dams mean in spatial terms, as a form of human relation with the inhabited space, the assumptions about the ideal space and their contradictions with the experienced environment become apparent. This can help in moving beyond entrenched positions and move closer to the heart of the dams debate. An emphasis on the meaning attributed to large dams in social, cultural and historical terms can create the basis for a more creative engagement, as opposed to a merely reactive one. At this point, it is important to mention that it is not the development of large dams as a technology to correct or alter the flows of rivers that is being examined here, but rather how the problem was constructed to which large dams were seen as the solution.

This chapter follows the tradition of a critical examination of technology in terms of human relations that are encompassed under the broad rubric of Science and Technology Studies (STS). However, the emphasis here is on the spatial or geographical aspect, and focuses on the influence of space on the evolution of the

technology of large dams and subsequently its impact on the space to which this technology is applied. A Geography of Science (GoS) approach is the conceptual framework used to relate the spatial context to the technology of large dams. The GoS perspective is employed in this chapter partially as a critique of the technology of large dams. However, merely identifying this particular technology as co-produced by its geography (and therefore lacking 'objectivity') is not the intent of this chapter. My argument here proceeds in two parts, with the first part focusing on the framing of the problems to which large dams are offered as solutions. The framing of the general problem in terms of the so-called hydraulic mission (Molle et al. 2009) is placed in its historical context, with a focus on the interplay of knowledge and space legitimised by notions of environmental determinism. The second part examines their efficacy as solutions. In the case of South Asia, this chapter argues there are several specific environmental features that make this technology, especially in the form it is normally applied, inappropriate in most locations.

The next section acts as a preamble introducing the conceptual framework and points out the possibilities inherent in a spatial examination of large dams, as well as the hydraulic mission that drives their proponents. Following this, a few contradictions inherent within the hydraulic mission are highlighted. The third section suggests some practical objections that arise from the incompatibility of the hydraulic mission with the geographic context in which it is pursued. This chapter is concluded by a discussion of the possible alternatives to the hydraulic mission and the possibilities for a more creative critique of large dams.

2.2 Placing Technology

The examination of the social and cultural influences on technologies has a long history in which the work of Thomas Kuhn on the scientific method (Kuhn 1996) is seen as a milestone. Following this, the fields of Sociology of Scientific Knowledge (SSK) and the broad area of Science and Technology Studies (STS) have achieved prominence in critical studies of technology. While its social, cultural and economic origins have received considerable attention, a focus on the spatial production of knowledge is relatively recent. The most fruitful engagement with the spatial aspect of science and technology has emerged from the field of GoS.[1] This approach relies upon the premise that knowledge is produced in a particular place, and, *where*

[1] A note on terminology is useful here, as there is a multitude of possible usages that are current, the most prominent being "Geography of Science" and the derivative "geographies of science" and the broader term "geography of knowledge". This paper uses the nomenclature "Geography of Science" as a device to ensure consistency and ease of understanding, but it is intended to encompass the broader idea of "knowledge". The implication of plurality is inherent when this term is used so broadly, and therefore, I do not use "geographies" as an additional rhetorical device.

knowledge is produced, has an influence on *what* is produced. As Livingstone asserts:

> Scientific knowledge is made in a lot of different places. Does it matter where? Can the location of scientific endeavor make any difference to the conduct of science? And even more important, can it affect the content of science? In my view the answer to these questions is yes (Livingstone 2003, p. 1).

This emphasis on geography has provided this field with a variety of key concerns, each with varying levels of overlap with other fields like Science and Technology Studies (STS) and Sociology of Knowledge. These fields assert that knowledge cannot be value neutral, and that the sociocultural milieu in which the knowledge is produced affects both the form and content of knowledge. Examples of this can be seen for instance in the role of social status, not just of the scientist, but especially of the audience, in establishing the validity of scientific knowledge (Shapin and Schaffer 1989). What distinguishes GoS is the emphasis on the role of space and place in the production of scientific knowledge.

Researchers working on GoS have confidently asserted that all scientific knowledge originates in a place and is influenced by it (Livingstone 1995, 2003). This is in itself a questioning of science, and by inference of technology, as what Nagel (1986) has called the 'view from nowhere' (cited in Shapin 1998, p. 5). Though a GoS perspective is inherently critical through its questioning of the universalist claims of the technology of large dams, the influence of geography on this technology is not remarkable in itself. What is remarkable is that the universalist claims of this technology have been so readily accepted. Once the spatial influences on the form and content of this technology are acknowledged, then its applicability to other locations can no longer be taken for granted and must instead be scrutinised afresh. Before proceeding to give the broad contours of the GoS, it is helpful to consider some examples of what it is *not*. An example of a trivial and simplistic way of dealing with the connections between place and science is that adopted by Dorn (1991). This work tries to identify ultimate origins of certain kinds of knowledge and uses a kind of geographical cataloguing of technologies and inventions, using an eclectic mix of cultural and political economic determinism, informed by a eurocentric perspective. This kind of self-indulgent cataloguing contributes little to our understanding and is often suspect in what is identified as important, as well as in its attribution of unique origins to technology. GoS on the contrary relies on a richer understanding of geography, viewing it as more than merely a set of fixed cartographic coordinates; instead, space is understood in terms of systems of relations between the environment, place and people.

Furthermore, GoS should not be confused with environmental determinism, or closely related arguments that focus on the geography, or more precisely spatial properties, as a sort of backcloth that creates the basis for what kind of knowledge is possible. An elaborate example of such recent work that has attained considerable popularity is Jared Diamond's *Guns, Germs and Steel* (1998), in which he attempts to explain away current inequalities among regions of the world as a product of environmental differences and geographic influences on societies. Blaut (1999) has

provided an excellent and detailed critique of this (and similar) work by placing it in a tradition of eurocentric history whose theological and racial underpinnings have retreated into the background, leaving environmental determinism as the 'scientific' explanation of European superiority.

Sheppard identifies another more contemporary function of this type of work, as a defence or justification of globalising capitalism:

> Diamond's geographical imaginary… leans toward a teleological account of economic development in which 'geography' disrupts the otherwise flattening playing field of globalizing capitalism (Sheppard 2011, p. 47).

Sheila Jasanoff has used the idea of *co-production* in order to avoid privileging either sociocultural or techno-scientific determinism in the study of technology (Jasanoff 2004, p. 20). Extending this idea of co-production naturally focuses attention on the influence of the geographical, cultural and social context on the production of the technology. Thus, large dams cannot be understood as abstract technologies but need to be conceptualised as co-produced by their context. This suggests that whereas the ideas on their technical functioning have arisen out of situated practice and experience, the meanings with which dams are invested are very much produced through the social, political and historical context in which they evolved.

It is easy to use the idea of the influence of place on the evolution of large dams for a parochial defence of the local. Therefore, an additional caveat needs to be offered, which is that a critique based on GoS is subtly different from a simplistic account that places local and nonlocal knowledge in opposition, where one is seen as necessarily better and the other is denigrated. An attention to the geographical influences *contextualises* the technology of large dams, without being a polemic attack on this technology. Paying attention to the context and bringing the universality of this technology into question does not imply its being universally inappropriate; there certainly are settings in which such technology may be valuable. The next section attempts the tightrope walk necessary to separate an *attention* to place in the evolution of knowledge from the *reification* of place as a determinant of the value of knowledge.

2.3 A Genealogy of a Mission

Different kinds of dams have been built all over South Asia and are mentioned even in ancient sources like the *Rigveda*, while elaborate rules on their maintenance are prescribed in the administrative manual *Arthashastra* dating back more than two millennia. However, the revival of dams can be traced back to the British in colonial India, and the construction of large dams truly took off in 1947, following the formation of the modern independent nation-states of South Asia. Colonial projects were primarily oriented towards profit extraction and revenue generation, giving these efforts a specific character that has been called 'colonial hydrology' (D'Souza 2006). The succeeding period had several features that distinguish it from

the colonial era, most remarkable of which is perhaps the sense of urgency with which dam building was pursued. This urgency was characteristic of this period and could be found in many countries, but especially in newly decolonising nation-states like India, Pakistan, Egypt and China. This overarching idea of transforming rivers and using up every drop of their water in the service of humanity has been called the 'hydraulic mission' (Molle et al. 2009).

The primary purpose of large dams has usually been identified as one or all of the three functions of flood control, irrigation and hydropower generation. In South Asia, the emphasis has traditionally been on irrigation, though it is now gradually shifting towards hydropower generation. All these efforts can be summed up as an attempt to create the ideal river which is predictable, useful and completely in the service of humanity. This ideal however is by no means the only one possible, since rivers have always been deeply implicated in terms of spiritual, aesthetic and cultural relations with nature, with a correspondingly differing conception of what the ideal river is or ought to be.

2.3.1 Theological Underpinnings

The origins of the normative ideal the 'hydraulic mission' attempts to recreate have been traced back to north-western Europe. Tuan Yifu (1968) traces the origins of the modern understanding of rivers to seventeenth-century Natural Philosophy. The key objective of this field of knowledge was to describe the world as the creation of a supreme being, considered omniscient, who had arranged a perfect nature for the providence of mankind. Science or Natural Philosophy at this time was not generally understood as an objective search for the truth but more as an endeavour that sought to explain the works of the creator. An assumption that was implicit in this project was that of God being a merciful provider for the needs of his chosen people. As these ideas were developing in north-western Europe, the local experience of rivers as even flowing, seasonal, predictable and perennial became the prism through which water became understood. Linton (2008, 2010) has extended these ideas to the development of the now universally recognised model of the hydrologic cycle and the founding of the International Hydrological Association. He argues that this period was the beginning of an era in which water became a 'modern abstraction' and was stripped of its social, cultural and spiritual properties. The ease with which dams and other modifications of rivers and water systems fit into this model is also remarkable, and its influence on the ideas guiding the iconic Tennessee Valley Authority (TVA) that came to life in this context are worth mentioning.

The physical geography of Europe, where modern hydrology was taking root, also left traces in all future conceptions of rivers and riverscapes, since defining the normal was done by taking as the standard the experience of water in parts of Europe. This, coupled with the theological underpinnings, led to a denigration not just of other experiences with water but also of other people living in places that

had an association with water that did not comply with the European normative expectations (Linton 2010).

> The notion that 'all the land' was well supplied with water was not unique to Ray. Whether out of ignorance or out of enthusiasm, the geographical fact of aridity was conveniently overlooked by proponents of what might be called the 'sacred' hydrologic cycle (Linton 2008, p. 633).

Large dams become desirable only when aridity is seen as an aberration, and not a normal fact of life. In the light of its theological underpinnings, large scale engineering of rivers was a way of reproducing the Edenic ideal of abundant water, which depended on a disparagement of other experiences of water. These perspectives fit in neatly with the prevailing notion of the civilising mission, and a correction of both moral and material nature was seen not only as necessary but also as an obligation upon the colonisers.

2.3.2 Tropical Nature

David Arnold has used the term 'tropicality', in a conscious parallel to the concept of orientalism developed by Edward Said (1979), to describe the imagination of the landscape of the *Other* (Arnold 2000) that is seen in the process through which the tropics were perceived to be another space with their own character, distinct from other parts of the world. Of course, there was no monolithic way in which the tropics were imagined, but common to all such ideas was the sharp distinction made between the tropics and the rest, and the attribution of shared qualities to all tropical areas. These notions were by no means always negative, and Arnold (2004) argues that a negative view of India as a place of disease and death was produced through the descriptions and experiences of colonial travellers and was distinct from the earlier view of tropical nature as abundant, fertile and rich. He further asserts that it was this changed perception of India as a ruined and desolate 'deathscape' that became the justification for the various administrative projects of 'improvement'. These early attempts at improving upon a natural environment perceived to be perverse were simply the precursors of what later became the project of modernisation.

A chance combination of factors, both human and natural, may have further contributed to the changed perception of India from a prosperous land of riches to an impoverished disaster zone. Mike Davis connects the especially severe famines of the late nineteenth century to droughts caused by a very strong El Niño/La Niña-Southern Oscillation (ENSO) (Davis 2000). This extreme weather event was compounded by the breakdown of traditional administrative structures of famine prevention, the *increasing* exports of food during this period and the incorporation into world commodity chains. The change of land use from subsistence farming to monoculture of cash crops across a large area also added to the vulnerability of local populations. Davis has called this process the 'modernisation of poverty'. The

simplistic understanding that famines are caused by a lack of food, or by agricultural failure, has been challenged successfully (Sen 1981). However, the perception of Indians being at the mercy of nature has endured.[2]

Further, the effects of tropicality were not just limited to a representation of the tropical environment but also extended to descriptions of the *moral* nature of its inhabitants. Livingstone commented on the briefly flourishing pseudoscience of ethnoclimatology and described a 'moral climatology' that was used to supply a scientific justification to the presumed connections between race, space and moral character (Livingstone 1991, 2000, 2002). The assumed connection between moral qualities like fatalism, superstition, passivity and the tropics was effective in creating the rationale for the governance of the colonised. These ideas not only served to legitimise the 'civilising mission' but also supported a depiction of locals as lacking agency and volition. These views were quite tenacious, and as late as 1965, the award-winning work of Nirad Chaudhuri (1965) firmly ascribed many perceived failings of India and Indians like laziness, passivity and ignorance to its tropical location. In combination with the natural disasters that were observable, this contributed to a view of the necessity of state interventions to ensure food self-sufficiency. This is a problem that was considered especially acute until the onset of the green revolution, whose ostensible success is often cited as justification for large dams (Dharmadhikary 2005).

With the beginning of decolonisation, it seems natural that the transformation of both moral and material nature went hand in hand. And the antidote to the colonial experience was seen as the active transformation of the environment, in this case rivers, in order to achieve a reversal in fortune. These ideas driving dam building are perhaps brought out most eloquently in Nehru's famous proclamation of dams as the 'new temples of modern India'. Far more telling than the use of this phrase is the resonance it found among government officials at large and also the broader public. The connection between religion, superstition and resultant 'backwardness' is a recurring one in the thought of Nehru (2004). Against this backdrop, the move away from sacred rivers, towards dams as temples, in order to create a 'modern' India was perhaps inevitable.

2.3.3 Environmental Determinism

One of the first acts of the parliament of independent India was to create a constitutional act to create the Damodar Valley Commission modelled on the TVA, which was very intimately connected to its myth of democratic and socially

[2]A billboard from the late 1990s at the site of a dam project, under the headline "Sardar Sarovar Project: A gift to the nation", states: "India must be self-sufficient in food to avoid going to the world with a begging bowl. Country needs many more dams to harness waters going waste to sea after disasterous damage of flood" (sic).

transformative development (Klingensmith 2007). This urgency to transform the landscape has many influences, but the shift in focus from dams that were profitable undertakings, to dams that were almost magical in their emancipatory potential, is remarkable. An engineer working on the Bhakra project described how the arrival of the Americans at the Bhakra project, initiated by the British, transformed the morale and the motivation of Indians, ushering in a patriotic pride in a project that was ostensibly going to transform the nation (Singh 1998). What connects this crusade to transform the landscape to fulfil the potential of the nation to the modern South Asian conception of rivers is the idea of environmental determinism.

In the urgency of decolonisation, all nations of South Asia joined the race for modernisation and tried to overcome the factors that they considered responsible for their poverty and backwardness. While racial explanations were no longer tenable, environmental determinism and cultural failings were the most acceptable framings of perceived backwardness. Whereas environmental determinism can be summarised as the argument that geography is destiny, dams were an attempt to modify the landscape to overcome destiny by correcting perceived shortcomings of the environment. In this context, those who advocated adaptation, or less drastic solutions to the problems of river control, were dismissed as backward and fatalistic. Where such allegations did not work against well-known critics of dams, they were labelled anti-national.[3]

Any genealogy is only a narrative imposed on what were essentially disparate events; however, the evolutionary path described here is an attempt to account for the fervour with which dam building was pursued. The problematic origins of this zeal might have been excusable, if they had not had the terrible consequences they did when applied to the South Asian context. The next section suggests some of the major contradictions that resulted from these attempts to transform the environment to create the imagined ideal rivers.

2.4 Hydraulic Mission and Its Contradictions

The examination of large dams conducted here does not focus on their technology, but on their logic. Due to variability of design and diverse practices, the performance of large dams is naturally equally varied. Further, the construction of all large dams does not necessarily derive from the hydraulic mission described earlier, and there is a long history of indigenous dam building by local kings and feudal lords with varied outcomes (Morrison 2010). However, the hydraulic mission as a national

[3]This practice has endured to the present day. In the 1950s Kapil Bhattacharjee was accused of being a Pakistani spy (Nandy 2001). In more recent times, many renowned activists like Medha Patkar and Arundhati Roy have been called anti-national and alleged to have connections to unnamed foreign powers. This reaction is all the more interesting, because of the unquestioned identification of dams with the nation and of meanings given to dams that extend far beyond their function.

project, driven by the imperatives described earlier, results in the set of common contradictions listed below, due to its very logic. Though there are many problems with the hydraulic mission, some become especially prominent when a spatial analysis within an STS framework is pursued.

2.4.1 Placeless Origins

Many of the key principles that underlie the thinking behind large dams rely upon the illusion of the placelessness of science that has been challenged in recent times (Livingstone 2003; Withers 1995; Naylor 2005). Many of the hydraulic principles upon which the hydraulic mission relies, like the hydrologic cycle (Tuan 1968; Linton 2010) and the river basin (Molle 2009), developed in north-western Europe and continue to bear traces of this geographical and intellectual context. One of the effects of this history is the reliance upon even flowing perennial rivers as the normative ideal, one of the consequences of which has been the denigration, or dismissal, of aridity and seasonality of other experiences of river regimes. Mike Davis (1995) argues that the 'humid fallacy' was a culturally specific prejudice based on the experience of annually and seasonally predictable precipitation in parts of Europe and the east coast of the USA. This norm of annual averages was extended to the very different Mediterranean littoral environment systems of Southern California, Chile, Australia and the South African Cape, which are characterised by extreme events and have oscillating dry and wet periods on the scale of 7–12 years. Calder (1999) has made similar arguments about the incompatibility of the normative ideals of the hydraulic mission with the hydrological experience in parts of Africa.

The lack of attention to the origins and the associated presumption of uniformity of experience directly contradict the diverse systems that exist in practice. Perhaps if the specificity of all these diverse hydrologic experiences had been recognised, then the misadventures in 'correcting' the water balance would not have had such disastrous environmental consequences in many parts of the world. Unfortunately, even today, hydrologic models continue to rely on concepts like annual stream flow and average rainfall, concepts which have little meaning in places where the 'average' is the exception rather than the norm.

2.4.2 Universal Replicability

In addition to the perceived placelessness of origins, another related assumption implicit in the hydraulic mission is the universal replicability of this technology. As the leading proponent of the TVA model, its chairman David Lilienthal proclaimed:

> 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… In 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, pp. 1–2).

This has meant that not only have even flowing, perennial rivers been unquestioningly accepted as the normative ideal for South Asian rivers; the means for achieving this flawed ideal have also remained similarly unquestioned. This fallacy is especially relevant when it is considered with respect to some conditions that are characteristic to the subcontinent. For instance, due to the unpredictability and high intensity of rainfall, the operation of reservoirs becomes difficult. Reservoirs may have to be emptied for the safety of dams, flooding downstream communities.

Many South Asian rivers, especially those originating in the Himalayas, have a very high sediment load. The resulting siltation of large dams has affected many reservoirs reducing their functionality. This is apart from the much greater ecological costs of keeping back as much as 25 % of sediments trapped within the reservoirs (Vörösmarty et al. 2003) that deprives downstream organisms and communities of nutrients and soil. However, this has for the most part been blamed on poor land management practices upstream, which has meant continued support for large dams, and indeed often the construction of additional check dams designed for the express purpose of reducing siltation. Not only does siltation lower the performance of dams, but this also has consequences downstream. A large study of rivers in India found 'dramatic reductions in sediment load in the tropical river basins… beyond the fold of assignable natural variability' (Panda et al. 2011, p. 108). The largest effect was found for the Narmada River, which the authors ascribe to dams. Further, they argue that the trapping of sediments has also significantly contributed to coastal erosion.

An additional factor especially relevant for South Asia is the high population density in many parts. This drastically increases the number of people displaced due to flooding by reservoirs, as compared to other parts of the world. Surprisingly enough, there are no accurate figures on the number of people thus affected, but their number has been estimated to be anywhere between 10 and 30 million, in India alone. Even when dams are built in areas with low population density, as in the Indian state of Arunachal Pradesh, those affected tend to be smaller tribal communities, significantly exacerbating the impact on social cohesion and cultural practices.

2.4.3 Ahistorical Development

Technologies are usually seen as being value neutral, and often the position of technologies, being neither good nor bad, masks the actual ideological traces within them. Thus, large dams appear to emerge from nowhere, and the connection to the context, in which the TVA emerged, is subsumed under its 'myth' (Hargrove 1994; Klingensmith 2007).

These same ideas when coupled with industrial capitalism, as in the case of the American south, then not only led to dams as a solution but also to the reliance upon 'largeness' as an additional desirable quality. Ironically the advent of large dams in the USA happened during one of the periodic crises of capitalism in the depression era, which manifested in a state-financed development of the TVA rather than one financed by private capital, as had previously often been the case for large dams in the USA. This reliance on state driven and large projects has continued to the present day, accompanied by an unquestioned belief in state directed improvement of life through drastic interventions.

2.4.4 Nationalised Environments

Instead of recognising the highly diverse ecological conditions across the entire South Asian region, governments in the region have seen nature as undifferentiated and in national terms (Baghel and Nüsser 2010, p. 241). This is evident from statements that speak of India as a water surplus country and in similarly deluded proposals to transfer water from 'water surplus basins' to 'water-deficient basins' through the interlinking of rivers (Iyer 2007, p. 50). Indeed, while the Indian proposals seem to have once again receded from the public imagination and from the policy planning process, in China two massive water diversion projects based on similar faulty premises are already fairly well advanced and beyond the planning stage (see Seeger, Chap. 3, this volume).

It has been suggested that this way of seeing the entire national territory as undifferentiated, or at least one in which variety is seen as an aberration, is directly related to the prerequisites of governance by the modern state (Scott 1999, 2006). From this, it can be argued that the hydraulic mission and the fallacy of a nationally homogeneous environment are essentially inseparable. The contradictions arising out of this lack of attention to ecological variability within the national territory are described later. A corollary of perceiving rivers as a national resource is that even their administration is done at the national scale, with the size of river control schemes being correspondingly large. Additionally, river planning at this scale contributes to conflicts over water sharing on both the international and interstate levels.

However, planning in terms of a single national environment is a direct contravention of the immense internal ecological variability of South Asia. In their classic work on the traditional water systems of India, Agarwal and Narain (1997) have identified at least 14 distinct ecological zones, each with a water management system that has evolved to suit local conditions. These diverse adaptations to local conditions include examples such as the *Zings* of Ladakh which are canal networks that make use of glacial melt, the *Kunds* of Rajasthan which are designed to store sudden and rare precipitation for long-term use and tank irrigation in parts of Southern India. In contrast with this, large dams are a single solution imposed upon a variety of requirements and local conditions. Although dams are in general

engineered differently to suit differing structural requirements, the identical strategy of a reservoir containing impounded water, distributed by canals, leads to high water loss due to evaporation and salinity in arid areas (Sakthivadivel et al. 1999). In case of rivers that have high sediment loads, for instance, in parts of eastern India, this same strategy leads to rapid siltation and loss of soil fertility downstream.

This internal ecological variability is in direct contradiction to the administrative prerequisite of a 'nationalised environment' as discussed earlier. The resulting governmental need for an easily replicable national strategy, combined with an inability to recognise local variations in environmental conditions, leads to poor performance and high environmental costs. Smaller scale solutions adapted to local conditions on the other hand may have the potential for better performance.

2.5 Dams as Anatopism

Apart from the numerous contradictions mentioned above, South Asia is also very densely populated, which makes the creation of reservoirs that flood large areas of inhabited space especially disruptive. This has contributed to social and political conflict, as well as created millions of internal refugees. South Asia also has a long history of agriculture, and local practices of water management have necessarily become well adapted to regional conditions. However, a modification of river systems at such a large scale has had cascading effects on agriculture downstream, and many of these formerly successful adaptations have now become unsustainable. In case of some parts of South Asia, flooding has worsened due to poor drainage, unplanned releases of water for dam safety, etc. When combined with the high population density, the transformation of flood and river regimes has magnified the effects of extreme weather events to catastrophic extents.

These factors mean that the use of large dams as a technology is questionable in most areas, and in fact the use of a variety of technologies tailored to the region in general and to specific ecoregions in particular is essential. By giving due attention to the spatial nature of knowledge, as well as its embodiment, the governance of river systems in particular and of all natural cycles in general can be significantly improved. It is also essential to not only level critique at individual instances of large dams, in which case criticism is easily deflected by pointing to specific problems (and solutions). By looking not only at the local scale and at the global scale as, for instance, in the case of the WCD (2000), but also introducing a scale sensitive to diverse ecological variations, the case of large dams can be addressed much better (Baghel and Nüsser 2010).

This addresses the weakness of studies that analyse large dams, but at the national scale, because this homogenises the nation as one particular kind of ecological space and loses sight of the appropriateness of the technology to specific ecoregions. The fallacy of 'national environments' is instead one that perpetuates the construction of large dams, and by using this level of analysis, a very important aspect of ecological variability and thus the varying appropriateness of large dams to specific ecoregions

is disregarded. Further, it is important not only to recognise space as having agency and variability but also to recognise the aspect of place which is dynamic on smaller time scales as compared to, e.g. geological changes in the biophysical space. As place includes not only the biogeophysical environment but also the notion of affect or emotional response to this space, it is important to recognise that not only do emotional responses towards the biophysical environment constantly change, but also they constantly acquire new meanings. This means, for example, that a river may have been seen as sacred earlier, and then as an industrial resource, and at another time perhaps as a source of aesthetic pleasure. A dam constructed on this very river would therefore not be constructed on the very same 'place', which means that even when a technology has been considered appropriate at one time, it may have become inappropriate due to a change in values and the dynamic nature of place.

This becomes readily apparent when the case of the demolition of many large dams across North America is taken into account. Dams that were once seen as a necessary evil have come to be seen as merely evil. This has often been a result of changing responses to the river from an industrial source to an aesthetic one, the idea of a place as being part of a salmon run, revaluation of species (e.g. the process of the former 'malarial swamps' becoming reframed as 'wetlands with biodiversity'). The changing character of place and the variability of space therefore are both essential factors to be considered when analysing the appropriateness of large dams.

Due to the legacy of a normative ideal of rivers that has its basis in colonial era moral and theological judgement of spaces and its inhabitants, dams continue to be attempts at creating a utopia. However, this utopian mission is subtly inflected with an attempt to recreate the ideal spaces of colonisers in an attempt to overturn their judgements. The attempt to impose these spaces and spatial qualities from elsewhere have resulted in the incongruities of rivers that are out of place and an anatopism in the spaces where they have been recreated.

2.6 Conclusion

This chapter has discussed the phenomenon of large dams in terms of their fit as appropriate technologies with respect to the diverse environmental settings of South Asia. While it is difficult to do such a complex topic justice in the limited space of this chapter, this critique brings into focus a very important but overlooked aspect of large dams as a technology, namely, their connection with space and time. This technology needs to be put into its spatial and temporal context. A case has also been made in this chapter for acknowledging the dangers of ignoring the connections between space and knowledge. Geographers are especially well suited for addressing this gap, and bringing in a spatial perspective can enrich the dam debate while making newer approaches possible. These may also break the stalemate and enable shifts away from entrenched positions that are based on a simplistic understanding of dams.

By undermining the certainties of the proponents of the hydraulic mission, this chapter identifies the question 'Are large dams good or bad?' regardless of the answer, as fundamentally flawed for its disregard of both space and time. It is argued that the question instead needs to be changed to: 'Are large dams appropriate for this particular space and time?' This question addresses both the appropriateness of a large dam for a particular location, in terms of the dynamic constraints it imposes upon the functioning of a dam. In addition, this question also incorporates the equally important element of the appropriateness of this technology to a particular time, with respect to the changing values of a society. This recognises that the choice of such a massive and disruptive technological solution is never value neutral, and as a consequence, both proponents and opponents need to make the values that guide them explicit and ready for examination. The recognition of large dams as situated within a particular time and place further leads us to rethink human-environmental interactions from ideas of 'man and nature', 'man against nature'[4] to one of 'humans in nature' (Meyer-Abich 1990, 1996; Berkes and Folke 1998; Berkes et al. 2003).

Fervent proponents of dams have at times placed them in the context of Hammurabi's famous inscription where he claimed 'I have transformed the desert plains into fertile fields, given their residents fertility and abundance, and I have made the country an abode of delight' (Costa 1911 cited in Molle et al. 2009, p. 330). However, a proclamation symbolising the hubris of dam building with a more appropriate irony might instead be found in the words of Shelley:

> My name is Ozymandias, king of kings:
> Look on my works, ye Mighty, and despair! (Shelley 1826, p. 100)

Acknowledgement I would like to thank the Cluster of Excellence: Asia and Europe in a Global Context and the University of Heidelberg for the generous financial and intellectual support provided during the writing of this chapter. I must also thank Prof Nüsser for his mentoring and advice, Thomas Lennartz for contributing his valuable organisational skills and all my colleagues in the Department of Geography, South Asia Institute, for their encouragement and support.

References

Agarwal A, Narain S (1997) Dying wisdom: rise, fall and potential of India's traditional water harvesting systems. CSE, New Delhi

Arnold D (2000) "Illusory riches": representations of the tropical world, 1840–1950. Singap J Trop Geogr 21(1):6–18

Arnold D (2004) Deathscapes: India in an age of romanticism and empire, 1800–1856. Ninet Century Contexts 26:339–353

Baghel R, Nüsser M (2010) Discussing large dams in Asia after the World Commission on dams: is a political ecology approach the way forward? Water Altern 3(2):231–248

Berkes F, Folke C (eds) (1998) Linking social and ecological systems: management practices and social mechanisms for building resilience. Cambridge University Press, Cambridge

[4]The original sexist language is retained here to reflect the phallogocentric nature of such positions.

Berkes F, Colding J, Folke C (2003) Navigating social-ecological systems: building resilience for complexity and change. Cambridge University Press, Cambridge
Blaut JM (1999) Environmentalism and eurocentrism. Geogr Rev 89(3):391–408
Calder IR (1999) The blue revolution. Land use and integrated water resources management. Earthscan, London
Chaudhuri NC (1965) The continent of Circe: an essay on the people of India. Chatto & Windus, London
CWC (Central Water Commission) (2009) National register of large dams – 2009. Technical report. Government of India, New Delhi
D'Souza R (2006) Water in British India: the making of a 'colonial hydrology'. Hist Compass 4(4):621–628
Davis M (1995) Los Angeles after the storm: the dialectic of ordinary disaster. Antipode 27(3): 221–241
Davis M (2000) The origin of the third world. Antipode 32(1):48–89
Dharmadhikary S (2005) Unravelling Bhakra: assessing the temple of resurgent India. Manthan Adhyayan Kendra, Badwani
Diamond J (1998) Guns, germs, and steel: the fates of human societies. Norton, New York
Dorn H (1991) The geography of science. Johns Hopkins University Press, Baltimore/London
Hargrove E (1994) Prisoners of myth: the leadership of the Tennessee Valley Authority, 1933–1990. Princeton University Press, Princeton
Iyer RR (2007) Towards water wisdom: limits, justice, harmony. Sage Publications Inc., New Delhi/Thousand Oaks/London/Singapore
Jasanoff S (2004) Ordering knowledge, ordering society. In: Jasanoff S (ed) States of knowledge: the co-production of science and social order. Routledge, London/New York, pp 13–45
Klingensmith D (2007) "One valley and a thousand": dams, nationalism and development. Oxford University Press, New Delhi
Kuhn TS (1996) The structure of scientific revolutions, 3rd edn. The University of Chicago press, Chicago/London
Lilienthal DE (1944) TVA, democracy on the march. Overseas Editions, New York
Linton J (2008) Is the hydrologic cycle sustainable? A historical-geographical critique of a modern concept. Ann Assoc Am Geogr 98(3):630–649
Linton J (2010) What is water? The history of a modern abstraction. University of British Columbia Press, Vancouver
Livingstone DN (1991) The moral discourse of climate: historical considerations on race, place and virtue. J Hist Geogr 17(4):413–434
Livingstone DN (1995) The spaces of knowledge: contributions towards a historical geography of science. Environ Plann D Soc Space 13(1):5
Livingstone DN (2000) Tropical hermeneutics: fragments for a historical narrative: an afterword. Singapore J Trop Geogr 21(1):76–91
Livingstone DN (2002) Race, space and moral climatology: notes toward a genealogy. J Hist Geogr 28(2):159–180
Livingstone DN (2003) Putting science in its place: geographies of scientific knowledge. The University Of Chicago Press, Chicago/London
Meyer-Abich KM (1990) Aufstand für die Natur: Von der Umwelt zur Mitwelt, 2nd edn. Carl Hanser, München
Meyer-Abich KM (1996) Humans in nature: toward a physiocentric philosophy. Daedalus 125(3):213–234
Molle F (2009) River-basin planning and management: the social life of a concept. Geoforum 40(3):484–494
Molle F, Mollinga PP, Wester P (2009) Hydraulic bureaucracies and the hydraulic mission: flows of water, flows of power. Water Altern 2(3):328–349
Morrison KD (2010) Dharmic projects, imperial reservoirs, and new temples of India: an historical perspective on dams in India. Conserv Soc 8(3):182–195
Nagel T (1986) The view from nowhere. Oxford University Press, Oxford

Nandy A (2001) Dams and dissent: India's first modern environmental activist and his critique of the DVC project. Futures 33(8–9):709–731
Naylor S (2005) Introduction: historical geographies of science – places, contexts, cartographies. Br J Hist Sci 38(1):1–12
Nehru J (2004) The discovery of India. Penguin Books, New Delhi
Panda DK, Kumar A, Mohanty S (2011) Recent trends in sediment load of the tropical (Peninsular) river basins of India. Global Planet Change 75(3–4):108–118
Said E (1979) Orientalism. Vintage Books, New York
Sakthivadivel R, Thiruvengadachari S, Amerasinghe U, Bastiaanssen WGM, Molden D (1999) Performance evaluation of the Bhakra irrigation system, India, using remote sensing and GIS techniques (Research Report 28). International Water Management Institute, Colombo
Scott JC (1999) Seeing like a state: how certain schemes to improve the human condition have failed. Yale University Press, New Haven/London
Scott JC (2006) High modernist social engineering: the case of the Tennessee Valley Authority. In: Rudolph LI, Jacobsen JK (eds) Experiencing the state. Oxford University Press, New Delhi, pp 3–52
Sen A (1981) Ingredients of famine analysis: availability and entitlements. Q J Econ 96(3):433–464
Shapin S (1998) Placing the view from nowhere: historical and sociological problems in the location of science. Trans Inst Br Geogr 23(1):5–12
Shapin S, Schaffer S (1989) Leviathan and the air-pump: Hobbes, Boyle, and the experimental life. Princeton University Press, Princeton
Shelley PB (1826) Miscellaneous and posthumous poems of Percy Bysshe Shelley. W. Benbow, London
Sheppard E (2011) Geography, nature, and the question of development. Dialogues Hum Geogr 1(1):46–75
Singh J (1998) My trysts with the projects Bhakra and Beas. Uppal Publishing House, New Delhi
Tuan YF (1968) The hydrologic cycle and the wisdom of God: a theme in geoteleology. University of Toronto Press, Toronto
Vörösmarty CJ, Meybeck M, Fekete B, Sharma K, Green P, Syvitski JPM (2003) Anthropogenic sediment retention: major global impact from registered river impoundments. Global Planet Change 39(1–2):169–190
WCD (World Commission on Dams) (2000) Dams and development. A new framework for decision-making. Earthscan, London
Withers CWJ (1995) Geography, natural history and the eighteenth-century enlightenment: putting the world in place. Hist Workshop J 39(1):137–164