Part I Water Systems and Development

1 A 'Water Systems' Perspective on History

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INTRODUCTION

A basic premise for this chapter and this volume is the notion that the way water flows through the landscape and in societies; the amount of falling rain and snow; their seasonal occurrence, duration and intra-annual variation; the types of rivers and the character of evaporation have affected all societies. Societies have always and everywhere adapted to, used, exploited and changed their water environments according to actors' technological know-how, cultural traditions, and ideological and religious worldviews, but within the constraints and possibilities created by the very same water systems. Due to its *permanent* importance water has a dual role of far-reaching empirical as well as theoretical importance. Water and changes in water control played a central role in the rise of civilization, since it was artificial irrigation that increased productivity and created the surplus necessary for state administrations and division of labour to develop. A secure, permanent supply of water and some sort of water distribution system have been a central aspect of all urbanization processes. Water was the main inanimate power source for almost 2,000 years, and recent research has shown that the different character of regional water systems was a very important factor in the water driven first phase of the Industrial Revolution.[1] The uncertainty about future climatic changes is basically an uncertainty about possible changes in the water landscapes of the future. Will there be more droughts or more floods, will water stored as ice melt and increase sea levels, and will the dams, aqueducts, pipes and canals people have built all over the world to exploit the local water resources be adequate if the physical water world changes? There can be no doubt that societies' relation with water has been a structure of fundamental social continuity through time and will continue to be so into the future.

The dominant social science tradition has, however, for logical reasons been rather disinterested in the role of water, or in nature in general, for that matter, because it has justified social science as being a science concerned with 'social facts'. The basic argument and justification for social science as distinct from the natural science tradition has been that social facts can and should be explained by another social fact.[2] The subject matter of the social sciences has, as a result, focused on the idea that humans, as social animals, should be understood only in the context of their social life, and the ensuing influences of interaction, social patterns and socialization.[3] Social sciences have in general studied humans as a unit, collectively within his or her *social world*, only. Sociology and political science were established in opposition to the naturalizing view of (natural and social) circumstances.[4] This early conceptualization of the nature/society divide was supported by and gained further influence from contemporary and dominant theories of modernity, whereby historical development was regarded as a process by which humans were liberated from nature or the powers of nature. Nature was seen as a primeval state to be transcended and mastered through science, technology and culture, and consequently its effect on societies should be ignored by social science; it belonged on another side of a deep ontological gulf.

Notions about the irrelevance of nature are also reflected in the most influential modernization theories, from those suggested by British social reformers and philosophers in the early nineteenth century to the theories following World War Two of universal development process, as promoted by the United Nations. These theories have influenced the international discourse on development for decades. Given these powerful evolutionary schemata for historical development and their political–ideological connotations, it was logical that the question of how societies were influenced by nature, or in our case the particular and special characteristics of the hydrological cycle, was seen as largely irrelevant and politically incorrect.[5] The constructionist school developed this point of view to the extreme, describing nature as nothing more than a social construct,[6] and arguing that such constructs reflected vested interests and social contingencies.[7] The task thus became to develop concepts of nature which conceived of it as socially constituted and culturally defined,[8] and the dynamism of the physical landscape was consequently concealed under the conceptual cover of social action.

The dominant tradition of nature scepticism among social scientists – and the fact that they still are, as the environmental sociologist Benton has called them, 'naturephobes' – distorts our understanding of society and social action.[9] As Richard White writes: 'physical nature

in this literature becomes peculiarly passive and inanimate. The powerful mistress of the determinists disappears into a hall of mirrors where we see, not her, but rather changing reflections of our own cultural progress'.[10] The environmentally oriented social science that has emerged since the late 1970s has been dominated by two 'schools' (one emphasizing the material–ecological substructures of modern society and the other the cultural–environmental aspects, reading nature as 'texts'). Many environmentally oriented social scientists have argued that it is important to integrate nature in analyses of historical and social developments, but have in practice integrated it as a backdrop only.[11] Nature is little more than a scene, sometimes attractive and sometimes ugly, but a scene nonetheless; a kind of preface to the social and political story that is subsequently told.[12] Nature is treated as an object of human contemplation and controversy or as the physical stage for what is quintessentially regarded as a human drama, taking place uninfluenced by the 'milieu extérieur'. Fernand Braudel, for example, one of the founders of the Annales School, who insisted on the relevance of nature and made it a major focus of his study of the Mediterranean world, basically confined nature or geographical factors to the introductory chapter.[13] Almost all the data about 'nature' can be found in the opening of the book, and the discussion of it acts chiefly as a preface to the largely social and political study that follows.

The knowledge that nature, and water for that matter, is socially mediated is a truism beyond criticism. Values, interests, conflict and power – in short, the social – shape our conceptions of the physical reality and influence its formation. Powerful cultural and social codes of vision influence how we perceive the external world, of course. It is necessary to study how nature, or in our case water, is mediated through society and society mediated through nature (water), but this cannot be properly done without grasping that nature, or water, also exists independently from cultural ways of knowing it. The physical characteristics do matter, but in ways that also depend on technologies, actions and ideas dominant at different places at different times. This means that it is necessary but not sufficient to locate social actions in wider sequences of social reproduction and transformation.

An inclusive, non-reductionist understanding of society requires an analytical approach that includes non-social facts about the physical, natural world. But in order to omit analytical determinism and reduce the influence and bias of contemporary nature-ideology on the analysis, it is also necessary to deconstruct the idea of the natural world, or of nature, as being one entity. Hence we need to oppose analytical approaches that argue that it is fruitful and possible

to research society/nature relations in general. Instead, concepts and analytical approaches should be developed that make research on and analyses of the relationships between the physical and the social, and of nature and ideas about it, more easy to undertake empirically and theoretically. This approach agrees with the argument that 'nature' or 'environment', as both concepts and facts, are so fundamentally different from terms such as class, race and gender that the analogy does not work, and the terms themselves distract researchers from another, more fruitful strategy for articulating the broader relevance of material nature for histories beyond the environmental realm.[14] The focus on 'water systems' is an effort to bring attention to the physical, biological, ecological, ideological and political nature of water, showing that such a focus will lead to new questions and new answers in relation to the past.

THE CONCEPT OF 'WATER SYSTEMS'

One of the key concepts used in this chapter is that of 'open and multifunctional water systems', or simply 'water systems'. The planet Earth has aptly been called the Blue Planet, so by focusing upon water systems we focus what made life possible on this planet, what made it habitable, and on a factor that was always necessary when societies were built and developed. All living organisms and the ecological system itself are sustained by the cyclical movement of water. Unlike all other elements in nature water has played a role in all societies at all times. It is therefore a truly universal resource. Water is simultaneously always particularistic and in flux, varying from place to place and from time to time. It has been increasingly recognized that the movements of water in the earth's crust, on its surface and in the air are exceedingly complex, and that they vary greatly both in the length of the path travelled and in the time taken.[15] This inherent dualism – the simultaneous embodiment of the universal and the particular – makes water particularly interesting from a comparative perspective since it has implications for how social development at different times and in different places can be made intelligible.

This concept consists of three different analytical layers.[16] A comprehensive analysis of society/nature relationships requires attention to all of these layers and their interdependencies. By combining these characteristics it is possible to reconstruct, describe, delineate and understand its movement and role in nature and in society and at the same time evade the problems created both by natural or biological determinism and social constructionism.

First and most fundamental is water's physical form and behaviour. This includes the precipitation and evaporation patterns from a nation, a region or other analytical unit; the way rivers run and water resides in the landscape in an extensive range of forms including, for example, lakes, glaciers and underground aquifers; and, where applicable, the particular interface between the rivers and the ocean. The 'water system' should be seen as an exogenous, physical factor, always in flux in nature at any given time. This physical aspect of the water system should not be regarded as a separate ecosystem, but as constituting a central part of any ecosystem. To understand this aspect requires knowledge and collection of natural science data, such as rainfall variations, rivers' sediment loads, evaporation patterns, hydrological data series, aquifer developments and so on, all of which are important, although of different importance to different societies.

The second layer of a water system consists of the actual human modifications to the physical water landscape. Any existing water system thus reflects not only natural and geographical conditions, but also societies' ability or determination to manipulate their water in the form of damming, draining, canalizing, embanking, storage, piping and so on. These efforts at water control must be analysed as located within a particular physical water landscape and a social and political and cultural tradition related to water and water control.[17] This concept also opens up the possibility of analysing the society which water runs through, since the form and level of any society's alteration of the water landscape they interact with will mirror technological traditions and managerial ideas, and also, in some cases, echo broader cultural patterns in the particular society in question.[18] No water landscape is completely artificial, because in the long term all hydraulic structures are vulnerable to climatic changes. Many water landscapes have been, and some are still, completely unaffected by human agency in spite of the fact that no other element in nature, to the same extent and for such a long time, has been the object of attempted human control.

The third and final layer of the water system constitutes the institutional and conceptual dimension. This includes the management practices and 'habits of thought' or ideas about water and water control (its religious/spiritual significance, including notions about purity), and other conceptualizations of water that have developed over time in different human/water contexts. This concept also encompasses the importance and permanence of water management practices in all societies, and how these habits of thought have over the centuries been influenced to different degrees

by the physical and hydrological context in which the actors operate.[19] This concept then does not ignore the ways in which nature is constructed, and that the way water is conceived in different places shows both the endurance and the instability of meaning, the coherence and fragmentation of habits of thoughts when it comes to water, water control and so on, but places this production of cultural metaphors in a water system context.

THE DEVELOPMENT OF EGYPT AND NORWAY IN A WATER SYSTEMS PERSPECTIVE

Perhaps it might be useful to briefly summarize the history of Egypt and Norway in such a 'water system' perspective, by way of illustration of the relevance of this concept and approach. Norway and Egypt represent two opposites in human/water relations. They therefore might be particularly apposite. These two case studies will show that 'water systems' are at work as a force shaping historical development, both those parts of it that do not emanate from humans alone and those that are caused by human actions. They will demonstrate how one cannot understand the history of these countries by discounting the nonhuman aspects of their particular water systems, without falling into the trap of mechanical determinism but by outlining how different kinds of 'possibilism' are distributed in these two countries with great inequality.

On the one hand, Norway, as compared to most other societies on the planet, is a unique 'El Dorado' of perennial running water from plentiful rain, which has been of fundamental importance for the country's historical development patterns. On the other hand, Egypt, which is almost 97 per cent desert, has almost no rainfall, and the country's economic, social and political life has for thousands of years centred on the Nile, a life-giving, societal artery. The role of the Nile for Egypt's development and the role of waterfalls for Norwegian industrialization is perhaps well known, but the point here is to show how a focus on this one element in nature makes new types of comparisons possible and useful. The chapter will briefly demonstrate an analysis of how the three layers of a water system are interlinked and interact, and together form a fruitful entry point for historical analysis.

In a comparative and global perspective, the nineteenth-century story about a landowner named Ring from Stabaek, just outside Oslo, embodies the fundamental character of Norway's particular water system and how it has shaped economic activities and technological practices over the centuries. The actors' actions reflected physical

structures and the agricultural possibilities that were created by the particular water landscape:

> At five o'clock in the morning on a clear and sunny day not long after the fields had been sown, he took a man with him and found himself a place at the edge of the field with his back to the sun. The man was equipped with a bundle of sticks. As the sun gained in strength, the earth would soon dry out and become lighter, except where there were sodden patches. Wherever he saw such a patch remaining, he asked his man to plant a stick. And this he repeated once every hour until noon. For every hour some of the patches disappeared, but where they were still visible, he asked his man to plant another stick. Eventually all the patches had vanished except perhaps one, where there would be maybe eight sticks standing, whereas at all the other points where there had been wet patches earlier in the day, there stood lesser numbers. The main rise of the water underground must therefore be where there stood eight sticks. On steeply sloping terrain they often found that such patches with sticks followed each other in a line. At these places he set short, strong stakes such as couldn't be broken during harvesting. And when that was finished he ordered the digging to be done. For this work he had ordered special spades which were twelve inches long and either twelve, ten, eight or six inches wide at the top and two inches narrower at the tip. For cleaning out the base of the gully he used a spoon-like scraper which was three and a half inches in diameter and an ell in length with a curved shaft, so that one could stand up on the edge and clean out the trench. For filling the trench he used stones, bigger ones underneath and smaller ones on top, but none of them bigger than six inches and none of them less than a half … If the base of the gully was heavily waterlogged, alder stumps would be sunk into the ground with their root end uppermost. On the meadow it was easiest to look for springs immediately after the hay had been taken in. On a warm and sunny day he took with him a large number of people and placed them side by side, barefooted, and with their toes pointing outwards and so close together that the toes of the one touched the toes of the person beside him. In this arrangement the company moved slowly forwards until someone among them felt it was cold under their feet. Thereupon he would call a halt, and a stick would be planted at the point where it was cold. In this way they continued, one strip after another, until the whole area had been touched and felt by bare feet.

The average precipitation in Norway is around 1,500 mm per year, or approximately double the average elsewhere in Europe. Moreover, only 10 per cent of the precipitation evaporates, whereas certain

countries have a rate of evaporation which exceeds the amount that falls as rain. The tens of thousands of rivers and streams and brooks that flow from the great accumulations of snow, ice and water in the higher mountains do not run directly into the sea. The 160,000 lakes and tarns, which cover almost 5 per cent of Norway's surface area, form natural reservoirs and ensure a relatively even water supply through the rivers for much of the year. Moisture is therefore stored in the soil all year. Although drainage required cooperative efforts among the farmers locally, these were less comprehensive and very modest in scope compared to the complex social organization and management required by the irrigation of dry land regions with scarce water resources. During those millennia when agriculture dominated the national economy, successful agricultural development in Norway was to a large extent a question of successful drainage. The challenge in most places was to get rid of excess water rather than bring water artificially to the fields. This fact had fundamental consequences for the very fabric of agricultural society. All over the country, including the eastern parts where rainfall was less than in the west and south-west, farmers worked to expel water. Oversaturation of water was a constant problem influencing the productivity of the soil and the harvest. The first agricultural settlements in Norway were typically located where the soil was naturally drained. One of the first big farms in Norway was called Sanner, which means 'sand', because rather than bringing water to dry sand, the task was to create fertile soil, or 'sand', from waterlogged clay.

The way in which the rain falls and is distributed over the Norwegian landscape, almost unnoticeable as a specific structure by the actors because it was so normal, influenced the development of the country's political and economic structures and institutions. Since the arrival of settled groups, the pattern of rainfall has provided conditions for a particular type of agriculture and land ownership and thereby for the development of specific relationships between the state and rural society. Precipitation is 'democratic' in the sense that it falls everywhere and on everybody's head or land. Neither feudal lords nor local kings (nor the state) could monopolize this vital resource in Norway. The way the Norwegian rivers flowed through the landscape created the conditions for a particular type of economy and distribution of economic activity, and thereby created a pattern of habitation and forms of social control. The nature of the rain and the rivers played a structuring role in the considerable political independence that the Norwegian peasantry came to enjoy. People could cultivate the soil almost wherever they liked without having to cooperate with others and without relating to complex social organization to make cultivation possible. In Norway the

peasants could always evade the power and control of the authorities. In Knut Hamsun's Nobel Prize winning novel, *The Growth of the Soil*, the main character is Isak Sellanrå. He is able to turn his back on society, and walk into the forested wilderness to start cultivating new land single-handedly. This character is not a universal figure, but a farmer – an agent who is a product of a particular north-western European water landscape. In areas where access to water has presupposed extensive cooperation and organization, the laying of new land under the plough generally involved submission to the authority of a strong state or leader or some sort of collective, communal organization.

If we turn to Egypt and the Nile valley, we can see that the River Nile, from a long-term historical and ecological perspective, is most fruitfully conceptualized as an *a priori*, supra-individual structure, which to various, differing degrees has framed human action and development efforts in Egypt and the rest of the basin.[20] The Nile River is the very lifeline of Egypt. In Upper Egypt, around the Valleys of the Kings and of the Queens, just outside ancient Thebes, several years can pass between rainfall events. In Cairo average rainfall is around 20 mm annually. Despite this, 2,000 years ago this desert country was the Romans' breadbasket. About a century ago it was a cotton farm for the British Empire. The explanation for these 'miracles' has always been the Nile and its annual flow over the country's borders, under a cloudless sky, like an umbilical cord surrounded by sand. The character of Egypt's water landscape has always made Nile control a top priority for its inhabitants and rulers. This is the case now, as it was about 5,000 years ago, when the 'Scorpion King' was portrayed commanding the Nile to flow out over the fields in a canal dug by men, and Menes, the first Pharaoh, dug a new course for the Nile to protect his capital, according to Herodotus.

The very fabric of the agricultural system in Egypt has been structured by the regional water system: the lack of rain, the evaporation rate and the Nile's behaviour. The regularities of the annual seasonal variations in the water discharge and the amount of fertile silt carried from the Ethiopian mountain plateau made a very productive agricultural economy possible. The technology it stimulated, which dominated the Egyptian economy for thousands of years, was flood irrigation, or basin irrigation. Every autumn, after the flood had passed its maximum, banks were built to keep the water in the fields as long as possible, to saturate the fertile soil. The dependence on the flow of the Nile also stimulated science and administration, since the need to anticipate the annual cycles of the river was of utmost political and economic importance, and the measurement of the flow was the main instrument to fix the

appropriate level of taxation. There is of course a big debate about the role of the strong state in building up this water control system and irrigation economy. However, all scholars agree that it required quite sophisticated social and political organization to maintain and develop, a very different case from that of Norway where rain-fed agriculture dominated.[21] And although scholars disagree about the character and importance of climatic and geological changes in the past,[22] all agree that any such changes would have profound implications for social structures, settlement patterns and political organizations in Egypt due to the importance of the Nile River as the main and often only source of water.

Many scholars have argued that the spread of water-mill technology was one of the major technological revolutions of the pre-industrial era.[23] A comparison between Egypt and Norway in this regard is also very instructive. Norway is in a unique position with regard to water mills. As mill technology spread through Europe, the tens of thousands of small rivers and streams made it possible for many farmers to establish their own mills. In France and other parts of Europe, where the rivers were fewer and less suitable for powering millstones, the regional administration or the nobility often secured control of and even a monopoly over milling activities. But in Norway a similar development would not have been feasible. In many districts almost every farm had its own mill. In the 1830s there were between 20,000 and 30,000 mills, a remarkably high number considering the country's population. In consequence the farmers enjoyed a high degree of control over the production of their own food, and did not need to crowd together around central mills or in other dense communities. Norwegian farmers could make their own bread without having to succumb to the power of a powerful mill owner, which was the norm on the European continent and partly also in England. The repetitive practice of making bread out of corn stimulated other power relations between the elite and farmers in Norway, different from those in France and other places where farmers had to succumb to the authority of the local *seigneur*. People who lived where there were no rivers, or on rivers where the current was insufficient or which carried too much sediment, were simply excluded from this technological revolution. The character of the Norwegian rivers was also the basis for what was Norway's most important export industry for more than 300 years from the sixteenth far into the nineteenth century: sawed timber. Rivers transported felled trees from deep inside the forests down to the fjords and also powered numerous sawmills. This was a service which the broader, more languid rivers in the vast forested areas of Sweden and Finland could not match.

Beginning in the early sixteenth century, the rivers of eastern Norway served particularly as the workhorses for the timber export industry and did so for more than three centuries. Both England and the Netherlands were in need of building material for both houses and boats. Formerly, planks and boards were cut and shaped with axes; the new boats and buildings required more refined materials. While other countries lacked timber and rivers that were suitable for driving gate-saws, Norway had both. The mechanism was simple. Via a transmission from a waterwheel the saw was moved up and down. The heavy, primitive saw blade was dependent on a river with sufficient power to keep the vertical waterwheel (sometimes undershot, other times overshot) moving. There were considerable woodlands across the whole of Scandinavia, but Norway's situation was particularly favourable. The country had rivers to float the logs to the ports on the fjords, and, more importantly, to drive the gate-saws, in places close to the ships that carried them to markets in the rest of Europe. Norway became Europe's leading exporter of rough-cut timber thanks to the properties of these rivers.

The timber trade remained Norway's most important export sector for centuries. But there were several reasons why it lost its leading position in this trade during the latter half of the nineteenth century. One reason was the advent of steam power (and later electricity), which liberated sawmilling from its dependence on rivers. At that point the forest resources of Sweden and Finland at last came into their own. This sudden transformation reflected the fact that Norway no longer enjoyed the benefit of having a water landscape of phenomenal comparative advantage before the rise of mobile power technologies. So, Norway's particular water landscape can explain the long period of successful timber exports, but it can at the same time also explain Norway's sudden downfall from this dominant position in the industry.

Few factors have been of greater importance for Norway's recent history than the fact that the rivers descend from relatively high altitudes. The energy latent in the water from rain and snowmelt in the mountains is therefore much greater than in most other countries. In order to produce 1 kW hour of electricity, 1 m^3 of water must fall approximately 400 m. Norway's rivers and streams and brooks descend in stages, through nooks and crannies, from a wealth of lesser and greater lakes, and onwards into a still greater number of streams and rivers, day in and day out, year after year. And for this reason there is no poetic exaggeration in calling Norway 'the land of a thousand falls': there are around 4,000 of them. River systems spread out across the entire country, and run in all directions. There

is no one river that dominates, gathering in the water from a single extensive catchment area, as does the Nile, in Egypt.

Thus Norway's rivers produced 'white coal', which made it possible for Norway to enter the industrial era at the beginning of the twentieth century. The best evidence of the country's unique position is the fact that, by the end of the 1920s, there were more than 2,000 power stations scattered about the country, whereas some other countries still had only one or very few. Norway had become a developed country thanks once again to the faithful service of its rivers. Today Norway is still one of the biggest producers of hydroelectric power in the world.

Egypt, on the other hand, had virtually no place to put a water mill. The only place in the entire country where one could find a water mill in the nineteenth century was in the Fayum depression, outside the Nile proper, where it could be driven seasonally by Nile flood waters which formed a seasonal and sometimes year-round lake.[24] In the eighteenth century some mills were established in connection with the barrages built on the river to even out the flow in order to increase the area under all-year irrigation. But the irregularity of the amount of water, its potential to produce mechanical power and the amount of silt it carried with it in flood made this technology unviable. That Norway had more than 30,000 mills and Egypt only a handful, and that Norway had thousands of saw-milling industries while Egypt had none, are social facts with wide-ranging consequences. But this cannot be properly explained by another social fact or social-produced structures alone.

Moreover, Egypt lacked places to establish hydropower plants in the nineteenth or early twentieth centuries, during the period when Western Europe industrialized and Norway was modernized (mainly due to its ability to utilize its exceptional water power resources). Neither of the two countries had coal, so the power source had to be different from that driving the industrial revolution in continental Europe and beyond in the second half of the nineteenth century. Egypt's only river could not be harnessed for hydropower due to the character of the river, the limitations of available technology, and the importance of and the priority given to the irrigation economy. The Nile was too mighty and too seasonal in character to be tamed for all-year power production. In stark contrast, there are 25 water falls even within the city limits of Norway's capital, Oslo, that could be exploited as a source of mechanical power in the early part of the nineteenth century, and thousands of small and big waterfalls in the country as a whole that could easily be exploited for running the new turbines of the latter half of the nineteenth and the beginning of the twentieth century. Additionally, while irrigation required the storage

of water from the wet season to the dry season, hydropower production requires a relatively uniform flow of water. This was a conflict of interests that the two sectors in Norway did not experience because of the dominance of drainage in agriculture and the utilization of waterfalls for power in the mountain areas, often far from main agricultural centres, so both agriculture and industry could develop side by side, the one benefiting from the other.

The water system has also had a bearing on geopolitics and foreign policy. While all the important waters in Norway are internal and nationally owned and therefore not an important foreign policy issue, the character of Egypt's water system has also shaped her geopolitical situation and the political strategic thinking of the political elite. The nightmare of upstream states diminishing the Nile discharge in Egypt has influenced Egypt's geopolitical considerations for generations. Egypt is a downstream state in a river system it is totally dependent upon. Egyptians cannot liberate themselves from this particular geopolitical position caused by a geographical fact, as long as they need the Nile's waters. The river is over 6,500 km in length, and if the river were rotated 180 degrees so it flowed to Cairo from the north rather than from the south, then the source of the White Nile would lie far up in the North Sea. The river system covers an area which is about ten times Norway's total land area, or more than double the size of France, Spain and Germany combined. It is hardly surprising that Egyptian political leaders over generations have developed a so-called 'downstream complex'. During the twelfth century it was claimed that several years with low water levels were the result of the drive of Ethiopia (Abyssinia) to punish Egypt for the Egyptian Christian Coptic Church's interference in the internal affairs of the Orthodox Church in Abyssinia. At that time the fear was irrational. But today technological progress has diverted focus on Nile water upstream of Egypt. Together with the dramatic growth in population and rapid economic development in large parts of the catchment area, this has further stimulated Egyptian downstream mentality. The hydrology of the Nile also had a decisive influence on the direction of the race for Africa and the way in which British expansion occurred.[25]

The Egyptians fundamentally changed the natural structure of the Nile system by building the Aswan High Dam. Nowadays the river is entirely under human control in Egypt. The dam creates an artificial lake roughly 500 km in length. Completed in 1971, it was the culmination of a revolution that began back in the nineteenth century. The area under cultivation in Egypt has been multiplied several times in the course of a hundred years. Three harvests can now be made each year. The annual flood and the seasonal cycles

that were the pulse of Egyptian agricultural, economic and ceremonial life for thousands of years became a thing of the past. The Aswan Dam made Egypt effectively the master of the Nile within its own borders. Since the dam could hold back two years' discharge of the river, the country was spared from the worst of the consequences of a several-years' drought during the 1970s and 80s in the Horn of Africa. While hundreds of thousands of Ethiopians died, Egyptian farmers continued to cultivate their fields as before. Although the dam changed the Nile's behaviour in Egypt, it did not liberate the country and the political actors from the power of the structure of the water system itself. The dam made the Egyptians more dependent on the Nile than ever before. As a geographical phenomenon, the Nile both restricted and opened up options for political strategies and initiatives.

In addition, therefore, to studying the social order and the changing Nile landscape as a result of individual intentions and state strategies, it is fruitful to study national politics and regional water politics as affected by both social and geographical orders. The Nile valley is a dynamic social category, and not only a physical setting for interaction. But the maps of interest are reflections not only of a mental world, but also of a material, physical world. It must be important to escape that fallacy which is so widespread in social science and history of either regarding such physical space as simply a physical given for interaction, or explaining the spatial or the regional only in terms of the social. By focusing on the relationship between the hydrology of the Nile on the one hand and the character of the basin-wide policies on the other, the analytical perspective can move between several foci, from the political circles and diplomatic missions to administrators and political activists placed along various parts of the river; from the people who lived there, to the place itself and its most significant geographical economic and political factors.

The hydrological character and changes in the Egyptian and Norwegian water landscape have framed the history of these countries and played significant roles at important junctions in these countries' histories. The importance of these areas' water systems can show that the historian and social scientist must understand meteorology, hydrology, sedimentation processes and the potentiality for dam sites and mill sites in order to make sense of history or social development. Social facts can and must also be explained by non-social facts and non-social variables, such as the nature of a river or of rainfall patterns, or the character of the local, regional or national hydrological cycle. The physical aspects of water systems impose themselves upon society, whether the actors are

aware of it or not – in the long run, undoubtedly, but also in the short term. In the productive activities these water systems encourage, men and women have changed their social world, the waters and their ideas about water and the society itself.

ANALYTICAL APPROACHES, WATER SYSTEMS AND NARRATIVES

The term 'water systems' encourages and makes possible analysis of the degree of human interference and control of water, and its influence on societies, on a continuum (the relative importance of the three layers will vary according to specific places and time in history) and over time. The concept provides a means of seeing our world and our history as products of both human and non-human actors, because the empirical character of the water system has been a varying factor in all societies' development. The term recovers water as an autonomous actor and the autonomy of the social, without rejecting cultural and spatial contexts. It encourages research on nature existing independently from cultural ways of knowing it, but at the same time allows for an understanding of nature, or in this case water, as always being understood through cultural lenses.

Many of the chapters which follow in this book serve to highlight the importance or necessity of understanding the history of water and society from a 'water system' perspective, partly in order to explain developments that have not been properly understood or have been neglected, and partly to throw new, original light on well-researched questions. They also emphasize the need to reinstate a degree of autonomy or causality to the natural states of water and hydrological configurations. If we first take the perspective of adopting a multilayered water systems approach, Richard Hoffman's account of medieval river systems serves very well to outline the complexities involved. Rivers already at this time were multilayered entities with overlapping uses, jurisdictions and meanings. Transport systems, power sources for mills, waste disposal systems, industrial sources, fisheries, and so on, all had to be accommodated, in addition to the more basic uses as sources of irrigation in some areas of Europe or drinking water (for humans, or livestock). These uses existed often in a state of local, regional and national jurisdictional and riparian tension, within a legal, political and cultural morphology. Eva Jakobsson's study of riparian issues in Sweden paints a similar picture of competing interests and mediation, as the flow of the river was competed over from the seventeenth century onwards. Fred H.

Lawson's study of the Nile in Ottoman Egypt similarly points up the long-term institutional and political control issues involved in the management of the river, and re-examines the influential and much-debated legacy of Wittfogel in a new and different historical context, trying to tease out the connections between state formation and the control of water systems. The contours of imperial policy outlined by Chapman's study of the Deccan show that, in the case of the British in India, a peculiarly imperial gaze underpinned attempts at rationalization and control, which left a legacy down through the twentieth century.

On a smaller scale we can detect a reversal of this dynamic between water and society, though again a situation typified by a state of unfolding tension and uncertainty. Three separate studies in this volume trace the history of major urban developments on river systems, where the initial dynamics behind this development became outpaced by a growing economic or political imperative, which in turn fostered a constant series of initiatives aimed at controlling or reorganizing the flow of rivers. Rod Wilson's study of Edo and the Kanto region in Japan, Salvatore Ciriacono's study of the development of Venice, and Alexei Kraikovski and Julia Lajus' study of St Petersburg, all portray a similar story of successive engineering and political initiatives constantly compromised and reconfigured against a myriad of competing interests and ambitions stretching from the needs and beliefs of local tradespeople to the whims and schemes of various aristocracies. All these initiatives, conditioned and partly caused by the particular waterscapes, be it the rivers flowing into the Venetian lagoon or the short Neva River controlled to create St Petersburg, were in constant tension with changes in the river flow and shifting understandings of the river's place in the hydrological system.

If we turn to the idea that the continual role of nature in the history of water systems should be re-emphasized, then many of the contributions to this volume serve to demonstrate the importance of this perspective. Ancient civilizations are depicted as establishing control regimes, or systems of understanding hydrological cycles, which, though effective, are at the limits of contemporary technological and scientific thinking. The more modern the system, the greater impact scientific and technological control is expected to have, particularly after the developments of the eighteenth and nineteenth century related to the Enlightenment and rational interventions, carried through by an internal and external, nationalist and imperialist politics and state system, and a general developmental ideology. Throughout all these systems of attempted control, ancient or modern, the unpredictable role of nature, or of the natural

hydrological cycle has been a feature, and water systems can be fundamentally compromised for whole regions by weather pattern fluctuations on a global scale. Whatever the cause of the change in prevailing weather (and precipitation) patterns, the effects show that even quite sophisticated water systems are vulnerable to 'exogenous' change. A graphic example perhaps is provided by Richardson Gill in his account of the Maya collapse. Gill describes a very sophisticated system of water control and management, in a region with a peculiar hydrology and topography. In fact the region, and Mayan civilization which was built upon it, existed in a precarious water environment, where, again, a systemic change in regional or global weather patterns had catastrophic and unforeseen consequences. We can speculate on the causes of change in both these instances, but what is clear is that external 'natural' events led to the fundamental compromise of water systems and, in the Mayan case, the collapse of the centres of their civilization. Dan Penny's outline of the Angkor region demonstrates the ideological and cultural importance of water to Khmer societies, and the very sophisticated networks of hydraulic engineering upon which it was built. Substantial evidence points to the decline of Angkor, and these coincide with an identifiable climatic transition in the same period.

Other case studies from the ancient world serve to illustrate the ways in which nature is capable of asserting or re-asserting control over water systems. Nash describes how the particular physical aspects of the water systems in the dry areas of Oman were exploited and developed into the famous qanat-system, where whole areas were dependent upon man-made underground channels and a quite sophisticated system of water management and water distribution. Judith Bunbury, in her archaeological study of the ancient channels in the Nile delta, demonstrates the ways in which the river was always an unpredictable and uncontrollable entity in its lower reaches. The Nile has been the subject of many studies seeking to demonstrate that control of the flooding process, or at least the ability to predict and understand the river's seasonal fluctuations, formed the foundation upon which a political/ideological regime was based. Oestigaard's chapter on the cultural basis or importance of water system, and his new hypothesis of the role of the Nile and water in Egyptian cosmology, provides a clear demonstration of this process. Less has been written concerning the difficulty of controlling or accommodating the fluctuations in flow patterns or channel configurations in the lower reaches of the river. It is clear from the archaeological evidence that the river moved in ways which defied the long-term attempts of engineers, architects, planners and traders, to establish permanent trading facilities or habitation. A

similar pattern of long-term natural change, perhaps leading to social, cultural and political instability, is found in Gregory L. Possehl's study of ancient river systems in present north-west India and Pakistan. He shows that a number of rivers, and by inference their consequent social and economic systems, have in effect ceased to exist. In the third millennium BCE the pattern of drainage of the whole Punjab region was quite different from that of recent history, again pointing to the underlying power of natural forces in the face of human attempts at control. It might be more accurate to portray human interaction with such river systems as accommodational, rather than controlling in many respects. As Possehl points out, societies in the region have for many years lived with the unpredictability of rivers in the region, their propensity for extremely variable levels of flooding being a constant feature. Nevertheless, such accommodation is based on the seasonal fluctuations (extreme as they may be) in the activity of the river. When rivers cease to flow, albeit over a long period of decline, then this is natural disruption of an altogether different scale.

As noted above, it is tempting to depict ancient civilizations as more vulnerable to natural fluctuations and change in regional hydrology or river flows: understanding of the overall hydrological cycle was weaker, engineering remedies or systems less sophisticated and so on. However, several studies in this collection point to the unpredictability of rivers – the impact of nature – in the modern period. Leandro del Moral Ituarte's study of the development of hydraulic engineering in Spain, for example, shows the limits to early engineering solutions to river control. The catastrophic failure in the sixteenth and seventeenth centuries of advanced vaulted and curved dams, which were at the leading edge of technology at the time, served to reverse or compromise ambitions of hydraulic engineering, and arguably the political structures of Spain going forward into the eighteenth century. Richard Coopey's chapter on the rationalization of the river Severn in the eighteenth and nineteenth centuries also underlines the fragility of scientific and engineering knowledge in the face of unpredictable river flows and characteristics. In the latter case there is no catastrophic failure, but what is clear from a close reading of the accounts of the decision-making processes – which involved some of the most renowned of 'great' Victorian engineers, including Telford and Brunel – was that the precise 'natural' dynamics of the river, flows over weirs in particular, were still poorly understood in the mid-nineteenth century. This was at the high point of British engineering prowess.

Sometimes the scale of river flows has overwhelmed political, economic or engineering solutions. Trans-boundary rivers or watersheds

are a particular issue in this respect. The chapter by Miklos Domokos serves to underline this point. The Danube flows across Europe, through a succession of historical, political and national boundaries. Attempts to control and utilize the river have followed different trajectories depending on political and ideological configurations, scientific and engineering traditions and so forth in a succession of different countries at different historical periods. Europe has been criss-crossed by differing regimes of regional and national political control and of differing engineering cultures. The chapters by Toon Bosch and Jacobus de Vries point to these developments in relation to the major European rivers and important hydrological regions in the modern period, especially the Rhine, or the lowland reclamation areas in the west, and each in turn point to the limitations of successive policies of rationalization. The case of the Rhine serves as another salutary reminder of the complexity involved in ideas of engineering primacy and the triumph of rationalization. The river has become a by-word for 'engineering nature', a classic study of the way in which the unruly, even the meandering, river should be controlled, straightened and harnessed. Yet the consequences and limitations of these policies are still being played out. Similarly, generations of drainage and reclamation in Holland, which left a legacy of expertise and ideology which spread out across Europe and throughout the globe, is now being re-examined, and reclaimed land is finally being given up in the face of the inexorable intransigence of the natural water system.

The limitations of modern engineering 'solutions' are not a phenomenon limited to Europe. Martin Reuss tells a similar story with regard to the Mississippi, for example, in terms of the changing demographic, agricultural and industrial profile of the river, and the peculiar rationalization imperatives which this brought, but also in terms of the solution to the problem. Flood prediction, alleviation and control became a primary aim of policy. Unlike European counterparts, major rivers in the USA could come under the control of a single federal body, in this case the US Army Corps of Engineers. However, as the example of the Atchafalaya River shows, solutions were hardly ever predictable and stable, particularly in a river which is characterized in its lower reaches by shifting and quixotic currents and channels. A more modern example of a persistently recalcitrant river is highlighted in the case of the Yellow river. As Qiang Zhang et al. demonstrate in their chapter the river has had a turbulent history in terms of flooding and control, particularly in view of the very high sediment load that it carries, which is in turn a benefit and a problem, depending on which aspect of the 'water system' approach we chose. During the modern period the river has come under a

unitary controlling authority in the form of the Chinese state, and yet problems continue. As Zhang et al. assert, reservoir regimes, flow controls and so on remain in constant tension with the changing needs of Chinese society and economy and uncertainties about macro-climatic effects on the flow rate of the river.

NOTES

1 See Tvedt 2010a for a short presentation of this explanation and perspective.

2 See, for example, Durkheim's famous *The Rules of the Sociological Method* (1982), where the 'father of sociology' makes a clear exposé of this way of understanding social developments and the role of social sciences in explaining this development. The same understanding of social science can be found in a large number of books. For an overview of dominant sociological thinking on the issue, see also Coser 1971, Swingewood 1991, Giddens 1993, Stones 1998, Haralambus and Holborn 2002, and Gosling et al. 2003.

3 This view has also been criticized by some sociologists: see, for example, Murphy 1997. This book argues that the 'blind spot' of sociology is its blindness to the role of nature for understanding social life.

4 In Parsons' system theory the physical environment assumed a basic but largely passive role – and, importantly, one that was effectively analytically separated from the social and cultural systems.

5 The development theories that gained prominence after World War Two) – such as the modernization theory (1960s), the 'basic need strategy' (1970s) and the so-called 'right-based' development strategies of the 1990s – did not consider the role of 'nature' in general or water in particular and how such physical contexts affected possible development patterns and development options available to different countries or regions. Although the UN and the World Bank give more and more attention to freshwater availability and development problems, water systems or 'nature' are not integrated in the same international development institutions' development strategies and development rhetoric. See for example the Annual Human Development Report, published by the United Nations Development Programme.

6 Typical examples include: environment has to be 'invented' (Macnaghten and Urry 1998: 32), or a 'fish is only a fish if it is socially classified as one' (Tester 1991: 46), or 'nature no longer exists' (Beck, Giddens and Lash 1994: 206).

7 Although nature in much of this literature is reduced to a social construct, it often suggests broad analyses of humans' relation to the physical world, which are highly questionable but fit into their broader analytical agenda. For example: 'The fact that nature threatens society is an experience known to all societies. Reacting to this threat with struggle is characteristic of modern society' (Eder 1996: 25). This

conceptualization of nature/society relations overlooks the many thousands of years of efforts at controlling rivers to avert flooding and drought and other natural catastrophes.

8 Eder 1996: 20.

9 This expression is taken from Benton 1991.

10 White 1985: 316.

11 Sociologists have argued that humans are natural beings, and like all species they relate in a reciprocal way with their environment. But environment has commonly been restricted to a biological understanding of nature: human beings or culture should 'be seen not as a category of behaviour separate from that stemming from genetically inherited tendencies and capacities' (see Dickens 1992: 18).

12 The most influential historical narratives of most individual countries (including Egypt and Norway, see below) typically have an introductory chapter about the natural or geographical scene of the country concerned, but very seldom is it integrated in analyses of concrete historical developments.

13 This is the case, also, for Braudel's very famous book about the Mediterranean world (Braudel 1975).

14 Stroud 2003.

15 Bierkens et al. 2008.

16 For a more thorough description of the 'water system' approach and the need to deconstruct the idea of nature as one entity, see Tvedt 2010a.

17 See Tvedt and Jakobsson 2006, and Coopey and Tvedt 2006 for a number of case studies showing how water landscapes have been shaped through time.

18 In some cases the new technology will be the result of 'external' actors more than local technology or culture, as is the case very often in international aid, and which was the case when, for example, the British, as colonialists, built the big Sennar dam on the Blue Nile in the Sudan in 1925 (for a detailed description of the history of Nile projects, see Tvedt 2004 and Tvedt 2010b).

19 A Chinese expression illustrates or summarizes this argument: 'As for those who protect and manage the dykes and channels of the nine rivers and the four lakes, they are the same in all ages; they did not learn their business from Yu the Great, they learnt it from the waters' (see Shen Zi in Ronan 1995: 239).

20 See Tvedt 2004 for this approach. An examination of the history, economics, politics and ecology of water in general and of the Nile river in particular was used here as an entry point for exploring the alignment of material structures and material interests in resource allocation and distribution. The choice of the Nile watershed as a study unit was not a conventional answer to the alleged crisis of nationally oriented history and social science, and of the modern territorial state and its legitimizing myths. The narratives were given analytical cohesion through the combination of an observable unity of a spatial construct and the dynamics of structural relationships related to a new basin-wide

planning concept for the river. These factors both created a framework for analysis and reflected an actual historical development whereby spatially differentiated societies, water economies, and relationships between water and humans or between the Nile and the societies it flows through had been brought together by a new conceptualization of the river as a hydrological unity and a planning unity.

21 For this discussion see, for example, Wittfogel 1957 and Butzer 1976. Wittfogel argued that a distinctive type of political system, absolutistic and bureaucratic in nature, tends to develop in arid or semi-arid regions which make the transition from hunting and gathering to agriculture. Butzer refutes this thesis, arguing that it is falsified by empirical findings. The present analysis of Egyptian history is limited to show how settlement patterns and economic structures develop differently in Egypt (also at different times) as compared to Norway, and do not put forward determinist arguments in the same manner as Wittfogel did.

22 See Bell 1970, Hassan 1981 and 1997, and Bunbury et al. 2009.

23 See Bloch 1935, Forbes 1956, White 1978, Reynolds 1983 and Gimpel 1988.

24 Willcocks 1889.

25 For a summary of this story, see Tvedt 2004.

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