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EVOLUTION OF WATER LAW AND POLICY IN INDIA

Philippe Cullet & Joyeeta Gupta

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Chapter 10
India: Evolution of Water Law and Policy

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Abstract This chapter examines the evolution of water law and policy in India from prehistoric to present times, briefly outlining pre-colonial developments and focusing on colonial and post-colonial issues and the complexity of regulating water in India. The resulting fragmentation of water law has not been overcome. Water law remains patchy today partly because it is a state subject while being also of concern at the union level and partly because elements of water law are in environment or health laws. Further, division of tasks between various social actors and levels is unclear. Water policy is pushed in a number of different directions, reflecting the specifics of the Indian situation, such as its complex administrative structure, overlapping and sometimes contradictory rights, vastly different endowments in water resources in different regions, and difficulties in allocating water in the most socially and economically appropriate manner.

Keywords Hindu law · right to water · water law · water history · water governance

10.1 Introduction: Historic Evolution

India is a subcontinent surrounded by the Arabian Sea on the West, the Indian Ocean in the South, the Bay of Bengal in the East and the Himalayas in the North. It covers about 3 million square kilometres, and includes 28 States and 7 Union Territories. It is home to about 1/6th of the world's population, more than 1,000,000,000 people.

P. Cullet
Philippe Cullet is Reader in Law at the School of Oriental and African Studies (SOAS), University of London
e-mail: pcullet@soas.ac.uk

J. Gupta (✉)
Professor at the Vrije Universiteit Amsterdam and UNESCO-IHE Institute for Water Education, Delft
e-mail: joyeeta.gupta@ivm.vu.nl.

India is criss-crossed by 12 major river systems. About 85% of the available water is used for agricultural purposes, 8% for domestic purposes and 5% for industry (FAO Aquastats 2003). Its long history can be traced back to the Indus Valley Civilization that emerged on the banks of the river Indus. Over the last 5,000 years, society has evolved under multiple kingdoms. It was often conquered by invaders from other countries, each bringing its own system of governance. Part of this story is recorded in historical accounts and records of visitors to India and part is unrecorded, giving a patchy, incomplete picture of the evolution of water management. Nevertheless, this chapter explores the available information to provide an overview of the key elements of the changes in Indian water law and policy over the centuries, focusing, however, on more recent developments.

This chapter first provides a brief history of water law in pre-colonial and colonial India, before moving on to discuss post-colonial water management in the country. It closes with the present decade to highlight current challenges.

10.2 The Pre-colonial History of Water Law

The pre-colonial history of water law in India (2500 BCE until sixteenth to seventeenth century CE) can be divided into an analysis of ancient India (2500 BCE until about the tenth century CE), and medieval India with the arrival of the Muslims through the Mughals after the sixteenth century. Water law in ancient India evolved slowly from custom, religion and written codes. This section elaborates briefly on the historical context and then focuses on the evolution of water law.

10.2.1 Historical Context

The Indus Valley Civilization flourished around 2500 BCE. Water was vital for the civilization and was used primarily for human personal use and irrigation. The most important structure in the city of Mohenjodaro was the Great Bath, which had water channels leading to and from it (Majumdar et al. 1978). Its remains can still be seen today. The Indus Valley civilization gave way to Indo-European invaders who were initially less settled in their lifestyles.

In societies of food gatherers, humans protected their environment because that was their resource base. Trees, groves, and water bodies were seen as sacred. As society evolved, specific trees and ponds were seen less as supernatural and the focus shifted to the earth, fire, wind, water, and sky. Varuna was the God of Waters and Indra was the God of thunder and rain. This often accompanied agricultural development that led to deforestation and changes in land use and forests then lost their supernatural powers. Gadgil and Guha (1992: 79) explain how forests and forest creatures were sacrificed to the sun god in the Mahabharata and see this as a way for the Pandavas to convert forestland into agricultural land. Drinking water was obtained from rivers, springs, and artificial wells (Majumdar et al. 1978: 30).

Agriculture was the principal source of employment and fields often required irrigation. Navigation was also a significant use of rivers (Majumdar et al. 1978: 34). Between 500 BCE and 300 CE, the large food surpluses implied no real shortage of water and supported trade development along water channels.

At this time, Jainism and Buddhism were born as counter religious forces to promote conservation of natural resources. Mahavir Jain and Gautama Buddha, who lived in about the sixth Century BCE, promoted right conduct and belief, and respect for fellow creatures. With the spread of agricultural settlements along the banks of rivers and on fertile lands, labour was needed to undertake specific tasks. Food gatherers were incorporated into the settled system of agriculture, through conquest or otherwise, as the lowest castes. Some argue that these lower castes subsequently began to follow Buddhist beliefs with its of ideas of non-violence. After the devastating war of Kalinga, the victorious Emperor Ashoka himself embraced Buddhism and preached non-violence and Ahimsa to his people. Ashoka also called on his officers to build reservoirs and plant trees (Majumdar et al. 1978: 100).

By 400 CE, there was a decline in Buddhism and Jainism and this was accompanied by a decline in agricultural production—possibly because of water shortages, decline in soil fertility, and/or the growth of human population. During the reign of the Gupta's and thereafter until about the 1000 CE, the lack of resources led once more to worshipping individual animals and trees and a focus on conservation. This was a period of low trade and urbanization. From around the ninth century, the development of new tank technologies and improved dams and canals in South India paved the way for the development of large-scale peasant agriculture that displaced pastoralism (Mosse 2003: 53).

10.2.2 Hindu Water Law

Hinduism is considered a living tradition that expresses universal truth. Each creature is made of parts and is part of the community and the cosmos. Harmony is achieved when human actions or *karma* match the nature of the human. Human actions are governed by *dharma* (law and order) that is concretized in the sacred books of the Hindus—the *Vedas*, which include the *Shrutis* and the *Smritis*. The Laws of Manu (*c*.200–100 BCE), within this tradition, provide indications of the water law of the time. Water was considered indivisible. Those who could were obligated to develop water works for the benefit of others (ch. IV, §§226, 229). Kings should protect public waters and collect fees for crossing waters (ch. VIII, §§61, 69; ch. IX, §§264–266, 281). Diversion or obstruction of waters was discouraged (ch. III, §151) and the laws imposed a system of social reprimands and punishments for those who polluted the water or who stole or diverted (ch. IV, §§46, 48, 56; ch. XI, §174; ch. VIII, §309; ch. IX, §281). Destruction of embankments was illegal. The law encouraged the use of water bodies as boundaries between villages to ensure that as many villages as possible had access to water (ch. VII, §§4–7). Water bodies of enemies, however, could be destroyed in times of war (ch. IX, §28). A water controller was in charge of water administration.

A manuscript—*Arthashastra* ('The Science of Politics')—also provides a detailed account of governance in the Kautilian period. It reflects the legal and political system from around 350 BCE to about 150 CE. The *Arthashastra* discusses the use of water for the development of water works, irrigation, and transport, specifying that all water belonged to the king and that users were to pay a water tax to withdraw water from irrigation systems installed by the king (Kautilya *c*.300 BCE–300 CE: 73–74). The system of taxes was very elaborate. When new tanks and embankments or renovation works were undertaken or when water works were cleaned and made ready for use, there was a 5, 4, or 3-year exemption from taxes. There were limited provisions for private ownership and these included immovable properties such as reservoirs, embankments and tanks, with the owners having the right to sell or mortgage these. Where such tanks were not in use for a period of 5 years, ownership rights lapsed. All those who leased, hired, or shared such a body had the responsibility to maintain them. Private owners were allowed to give waters to other parties through irrigation works in exchange for produce. The taxes that owed to the King were specified in great detail (Kautilya *c*.300 BCE: 231–232) and these were collected by the Chief Superintendent of Crown Lands (Kautilya *c*.300 BCE: 315).

The *Arthashashtra* stated that in irrigating one's own field, no harm is to be caused to others. It prohibited the release of water from dams without a legitimate reason, the obstruction of the legitimate use of water by others, the obstruction or diversion of the watercourse, and the building of water works on the land belonging to someone else. Where damage was caused to another party as a result of overflowing waters, compensation was owed to the other party. The *Arthashashtra* provides a list of damage types and the corresponding compensation or penalty due. These included the death penalty (death by drowning) (Kautilya *c*.300 BCE: 232–233). Water routes could be used for the purposes of transport and trade (Kautilya *c*.300 BCE: 623) and the principle of good neighbourliness was a civic duty.

The *Arthashastra* explains that there were four sources of law: The *Dharma* based on truth; evidence provided by witnesses; customs and traditions accepted by the people; and royal edicts adopted by the king. The *Arthashastra* submits that where a king rules over a territory, he should ensure *dharma*, and *dharma* only exists when there is order. Hence, if customs already exist in specific places, the king should allow the continuance of the custom. Once the king makes a rule, however, he should ensure enforcement. The *Arthashastra* elaborates in great detail on foreign policy, but does not say much explicitly about water. It leaves room, however, for treaties to develop joint water works.

10.2.3 Islamic Water Law in India

From the tenth century onwards, Islamic rulers governed Northern India. Subsequently, the Mughals came to power in the sixteenth century and stayed in power until European colonialists took power. This implies that Islamic rules were probably introduced in this period. Islamic law principles (see Naff, this book) include that water is a gift of God, that no individual or ruler can own water,

and that everyone should have access to water (Naff & Dellapenna 2002: 477). These principles include a right of thirst, which gives humans and animals the right to quench their thirst from any available water point (Faruqui 2001).

The influence of Muslim rule in India on water regulation has not been conclusively ascertained (Siddiqui 1992: 295). Islamic rulers refrained from significant intervention in existing arrangements, generally applying Islamic law to the Islamic population while allowing non-believers to follow their own systems. Possibly, the relatively high availability of water in India precluded conflicts with Islamic norms (Siddiqui 1992: 289). This may also explain the relative lack of attention towards water regulation during this era (Siddiqui 1992: 295).

10.2.4 Colonial Policies and Laws on Water: Government Ownership

From the sixteenth century onwards, European colonialism began in India. It accelerated during the industrial revolution in England. Colonization brought three major influences—a transformation from a resource gathering and food production economy into a commodity-oriented economy; a change in long-standing social relations and customs as local social relations became less important and social cohesion declined; and the development of the market and the importance given to wealth (Gadgil & Guha 1992: 116). Commercial production became more important than subsistence, exploitation more important than conservation, and the individual more important than the community. While colonization in India was less aggressive than in Africa, the British deforested large tracts in order to access coal and timber and to promote agriculture. The state gradually took ownership of forests and community irrigation and usufructuary schemes were dismantled. Water logging and salinity problems increased and small-scale irrigation schemes broke down leading to impoverishment of the small farmers.

The British introduced the concept of government control over surface waters. In the early stages, legal and administrative changes were motivated by the need for colonial expansion and to amass wealth, the East India Company focused on advancing trade and traffic, and law developed through practice and the judicial process (Siddiqui 1992). Until 1857 the British did not interfere with local rules and customs unless it interfered with their policies. The Presidency areas were completely subject to British rule, mofussil areas experienced a plural system of law, and further away local systems of law existed. A few laws were enacted such as the Bengal Regulation VI of 1819 to regulate ferries and the Charter Act of 1833 was an initial attempt to codify the laws in India. Following the 1857 revolution, the British began to consolidate power focusing both on famine relief and the need to maintain the resource base of trade (Majumdar et al. 1978). The British began to invest in and regulate canals and irrigation facilities.

British colonial water law had two main strands. First, control over water and rights to water were regulated through the progressive introduction of common law principles, emphasizing the rights of landowners to access water. For surface

waters, riparian rights allow a landowner the right to take a reasonable portion of the flow of a watercourse (Dellapenna 2001). For groundwater, landowners had a virtually unlimited right to access water under their holdings. Common law principles, enshrined in the Indian Easements Act (1882), evolved over time but have substantially survived until the present day (Getzler 2004). Second, a series of regulatory statutes were enacted, including laws to protect and maintain embankments, to acquire land for embankments, and to entrust the Controller for implementing such laws (e.g., Embankment Regulation 1829; Bengal Embankment Act 1855; Siddiqui 1992). Other laws regulated canals for navigation purposes and levying taxes on the users, river conservation, and rules on ferries and fisheries (e.g., Northern India Ferries Act 1878; Indian Fisheries Act 1897). Regulations recognizing local practices and rules in villages were also enacted.

One of the most important enactments was the Northern India Canal and Drainage Act (1873), which regulated irrigation, navigation and drainage. While this Act did not directly assert the state's ownership over surface waters, it recognized the right of the Government to 'use and control for public purposes the water of all rivers and streams flowing in natural channels, and of all lakes' (Preamble). This led to the progressive strengthening of state control over surface water and the concomitant weakening of people's customary rights. This tendency was progressively strengthened. The Madhya Pradesh Irrigation Act (1931: §26) provided that: 'All rights in the water of any river, natural stream or natural drainage channel, natural lake or other natural collection of water shall vest in the Government'.

Colonial legislation also introduced the division of responsibilities between the centre and the regions/states with regard to water. The Government of India Act (1935) empowered the provinces to take decisions on water supply, irrigation, canals, drainage and embankments, water storage and hydropower. Conflicts between provinces and/or princely states were subjected to the jurisdiction of the Governor General who could appoint a commission to investigate the sufficiently important conflicts (§§130–134).

10.3 Post-colonial Water Law and Policies

Water law in the post-colonial period is shaped by the legacy of colonial times, constitutional and federal developments, specific rules on surface and groundwater irrigation, human rights, social and environmental issues, issue about dams, and questions of water cooperation with neighbouring countries.

10.3.1 The Legacy of Colonial Times

Since independence in 1947, most states have regulated territorial water bodies, embankments, drinking water supply, irrigation, floods, water conservation, water pollution, rehabilitation of the displaced, fisheries, and ferries (Siddiqui 1992).

While significant novel aspects were introduced, the evolution from colonial water law was slow. Many colonial acts have not yet been superseded and the basic structure of common law rights linking water rights and land rights has not yet been comprehensively reworked (Singh 1991). Since the early 1970s, signs of more fundamental changes have emerged, possibly attributable to the fast decreasing per capita availability of water, increasing pollution of existing water supplies, the fast increasing use of water for irrigation, and increasing competition among water users for a larger share of finite supplies. Another colonial trend that has continued is the increasing displacement of customary and local rules and practices by formal state or central laws. While formal law and policymaking does not directly relate to customary practices, new water rules and policies have the direct or indirect effect of displacing or replacing existing local institutional arrangements and rules.

10.3.2 The Constitution and Union Legislation

The Constitution provides for the continuation of all laws in force at the time of the adoption of the Constitution (1947: art. 372). It generally follows the scheme introduced in the Government of India Act (1935), where water is a state subject. States have the exclusive power to regulate water supplies, irrigation and canals, drainage and embankments, water storage, water power and fisheries (Constitution 1947: Schedule 7, List 2, Entries 17, 21). There are restrictions regarding the use of interstate rivers (Schedule 7, List 1, Entry 56). The Union is entitled to legislate on shipping and navigation on national waterways, on tidal and territorial waters (Schedule 7, List 1, Entries 24, 25, 57); and on the adjudication of inter-state water disputes (art. 262). The latter was regulated in the Inter-State Water Disputes Act (1956). It creates specific tribunals for addressing interstate water disputes. This Act has been used in landmark disputes concerning the Cauvery, Krishna-Godavari, and Narmada rivers. The Krishna-Godavari began in 1951; a key issue was whether initial agreements about diversions from the river were justified given legal and political changes following independence (D'Souza 2006: 137). The Cauvery dispute between Karnataka and Tamil Nadu is more than a century old and relates to water sharing. The Narmada dispute focused on the use of available water by riparian states and provided the framework for the construction of the Sardar Sarovar dam, situated in Gujarat, but whose submergence zone is mostly in Madhya Pradesh and Maharashtra (Narmada Water Disputes Tribunal 1979).

The Parliament also enacted the River Boards Act (1956) to allow the Central Government to establish river boards to advise state governments on the regulation or development of an interstate river or river valley. River boards can advise on conservation, control and optimum utilization of water resources, the promotion and operation of schemes for irrigation, water supply or drainage, or the promotion and operation of schemes for flood control (§13). This Act, however, has not been used in practice.

10.3.3 Surface and Groundwater Irrigation

Since independence, states have enacted irrigation laws that generally follow the pattern of colonial legislation. Surface water irrigation legislation until the 1990s displays little novelty in terms of basic legal principles. The Rajasthan Irrigation and Drainage Act (1954: §5) maintains the right of the state to determine whether surface water is to be used for irrigation or drainage schemes based on whether the scheme serves 'public purposes'. In Madhya Pradesh, not only has the 1931 Irrigation Act been maintained but also the 1949 Regulation of Waters Act vested [Au1] 'all rights in the water of any natural source of supply' in the Government (§3), as does the Bihar Irrigation Act (1997: §3a).

Since the Central Government does not have jurisdiction over groundwater, the measures that it can take are limited. The rapid depletion of groundwater as a result of extraction for irrigation and other uses over the past 50 years has led to policy development in this area. The central government formulated the Model Bill to Regulate and Control the Development and Management of Ground Water (2005). The Environment Protection Act (1986: §3(3)) established a Central Ground Water Authority to regulate and control development and management of groundwater resources. State governments, however, have been slow to respond, although recently a number of states have adopted groundwater acts. Although different, these state acts follow the scheme of the model bill. The main features are: (1) establishment of a groundwater authority under the direct control of the government; (2) the authority is given the right to notify areas where it is deemed necessary to regulate the use of groundwater; (3) the final decision is taken by the respective state government (Model Bill 2005: §5); (4) in any notified area, every user of groundwater must apply for a permit from the authority unless the user only proposes to use a hand pump or a well from which water is withdrawn manually (§6); (5) decisions of the authority in granting or denying permits are based on factors that include such technical questions as the availability of groundwater, the quantity and quality of water to be drawn, and the spacing between groundwater structures; (6) the authority also takes into account the purpose for which groundwater is to be drawn, without prioritizing domestic uses over other uses (§6(5)(a); the Model Bill only provides that the purpose is to be taken into account, while §6(5)(h)—the only subsection referring to drinking water—only considers it as an indirect factor); (7) all wells, even in non-notified areas must be registered (§8). The model bill provides for the grandfathering of existing uses by only requiring the registration of such uses (§7). Where water scarcity already exists, an act modelled after these provisions does not provide an effective basis for controlling existing overuse of groundwater and provides only a basis for ensuring that future use is more sustainable.

Overall, the model bill constitutes an instrument seeking to broaden state control over the use of groundwater by imposing the registration of all groundwater infrastructures and providing a basis for introducing permits for groundwater extraction in regions where groundwater is over-exploited. Besides providing a framework for asserting government control over the groundwater use, the model bill also

expresses limited concerns for the sustainability of use. It does not, however, propose a clear break from rules of access linked to land ownership.

10.3.4 Human Rights and the Social and Environmental Aspects of Water

While the Constitution does not recognize a fundamental right to water, court decisions deem such a right to be implied in Article 21 (right to life) (Muralidhar 2006). The right to water is arguably implied in the recognition of the right to a clean environment. In *Subhash Kumar v. State of Bihar* (1991, ¶7), the Supreme Court recognized that the right to life 'includes the right of enjoyment of pollution free water and air for full enjoyment of life'. In the Sardar Sarovar case, the Supreme Court directly derived the right to water from Article 21, stating that '[w]ater is the basic need for the survival of the human beings and is part of right of life and human rights as enshrined in Article 21 of the Constitution of India (*Narmada Bachao Andolan v. Union of India* 2000, ¶274).

While judicial recognition of a fundamental right to water is unequivocal, its implementation through policies and acts is not as advanced. Recent initiatives include the Rajiv Gandhi National Drinking Water Mission that seeks to ensure that all villages in the country get drinking water supply. The goal has not yet been achieved and significant gaps have been identified in policy implementation (Planning Commission 2006). For urban water supply, various cities have adopted regulations or laws to regulate drinking water supply. Regarding water pollution, one of the most important developments was the adoption of the Water (Prevention and Control of Pollution) Act (1974). This act seeks to prevent and control water pollution and maintain and restore the wholesomeness of water. It creates water boards to set standards and regulations for the prevention and control of pollution. The Supreme Court affirmed, in *M.C. Mehta v. Kamal Nath* (1997: ¶34), that water is a public trust, with the state as 'the trustee of all natural resources which are by nature meant for public use and enjoyment'.

10.3.5 Dams

In the past 6 decades, hundreds of big dams have been built in India to promote development. Many dams have been controversial, starting from the first major post-independence irrigation project, the Bhakra dam, which was hailed as a milestone for a long time and has come under increasing criticism in recent years (Dharmadhikary 2005). The rationale for big dams remains to increase the irrigation potential to foster food security, to generate power, and, in many cases, to provide drinking water. The rationale for big dams has shifted over time in keeping with the increasing criticism concerning dam-induced human displacement

and environmental degradation. Today, after the crisis in big dam building caused by the Sardar Sarovar Project controversy (Cullet 2007), dams are again being proposed as an alternative to carbon-based sources of energy in order to mitigate climate change.

The legal regime on dams includes the Guidelines for Environmental Impact Assessment of River Valley Projects (1985), which provide a general framework for assessing the impacts of planned projects, and the more comprehensive Notification on Environmental Impact Assessment of Development Projects (1994), which provides a framework for assessing the environmental impacts of planned big hydropower and irrigation projects. The notification has been amended repeatedly until a new Notification on Environmental Impact Assessment was adopted in 2006, further weakening the process of environmental impact assessment. In particular, the validity of a clearance was increased from 5 to 10 years, with the possibility to further increase this validity by another 5 years (§9).

Regarding human displacement, the main act that applies is still the Land Acquisition Act (1894), enacted with the interests of the colonial government rather than the interests of the displaced in mind. It gives the government significant control over the process of eviction and the displaced very few rights. There is no obligation to provide land-for-land compensation. After nearly 2 decades of debates, a Draft National Policy on Resettlement and Rehabilitation for Project Affected Families (2004) was proposed, followed by the more progressive Draft National Development, Displacement and Rehabilitation Policy (2005) that provides, for instance, for land-for-land compensation. This was superseded by the National Rehabilitation and Resettlement Policy of 2007 that backtracks on the proposals. There is only one case—the Sardar Sarovar dam—where the Tribunal set up under the Inter-State Water Disputes Act decided that the displaced should be given land-for-land compensation (Narmada Water Disputes Tribunal 1979). This proved controversial and Madhya Pradesh, for instance, proposes cash compensation instead of land-for-land compensation (Cullet 2007: 303).

10.3.6 Water Cooperation with Neighbours

India has entered into a number of treaties with its neighbours. Some of these agreements are to be in place for periods that range from a short time (30 years for the Ganges), to a long time (199 years in the case of the Kosi), to an indefinite time period for the Indus. Each agreement reflects the issues most important at the time of the negotiation. The earliest Indus agreements focused on sharing, while the more recent agreements focus on irrigation, power, and flood control.

The Indus Waters Treaty signed in 1960 by Pakistan and India led to the establishment of the permanent Indus Committee and the division of the river and its tributaries between India and Pakistan (Kalpakkian 2004; Salman & Uprety 2002). Cooperation has been relatively stable in water sharing, despite the stress in other issue areas.

[Au2]

India shares four key rivers with Nepal—the Kosi, Gandaki, Karnali, and Mahakali (Kalpakkian 2004; Salman & Uprety 2002). The agreements on the Kosi allegedly benefit India and there is tension between the two countries regarding water sharing. The 1996 Mahakali Agreement was a more balanced agreement and included a flood forecasting and warning system.

With Bangladesh, the Joint Rivers Commission was established in 1972 (Subedi 2005). The two countries share about 50 rivers but the bulk of the stress has focused on the Farakka Barage. In a 1996 treaty, both countries attempted to negotiate a settlement with respect to this river. But since the agreement does not cover the other riparians, its long-term effectiveness is unclear (Salman & Uprety 2002).

A key issue is that although China is the upper riparian on several rivers flowing into India, there are no watercourse agreements with China. There are reports that the waters in Tibet could be diverted to meet the needs of northern China. If that does occur, this would lead to considerable stress between the two countries. In 2002, a memorandum of understanding was signed between China and India for sharing relevant information and may form the basis for future cooperation.

10.4 Recent and Ongoing Water Law and Policy Reforms

Over the past 2 decades, renewed interest in water law and policy can be ascribed to increasing water scarcity, increasing water pollution, competition among users for a finite resource, progressively changing economic policies at the national and international levels, and new water policy priorities at the international level. The following subsections address the current situation and the likely developments regarding water policies and the controversial river linking project.

10.4.1 National and State Water Policies

By the 1980s, it became evident that while water was largely a state subject, the lack of a national policy on water was a major impediment to the development of coherent water policies. This led to the development of the National Water Policy (1987) that was reformulated in 2002. The two documents are similar, focusing on developing a data bank, estimating the available water, prioritizing water (with access to drinking water accorded priority), developing groundwater rules, meeting drinking water needs, developing irrigation facilities, encouraging the participation of stakeholders in water management, monitoring water quality, promoting conservation consciousness, developing a flood control and management system, using cost effective measures to minimize erosion, maintenance and modernization of water works, ensuring the safety of structures built on water bodies, developing relevant science and technology, and training of personnel. The key differences between the documents are that the 2002 policy focuses on the development of an improved institutional framework with a focus on improving

the performance of the institutions, promotion of rehabilitation schemes for the displaced, enhancing participation by private parties in water management, developing an effective monitoring system, and ensuring that states share the waters of a joint river.

The national policy has been supplemented by state water policies. The national and state policies are based on similar principles: water as a natural or economic resource that can be harnessed to foster the productive capacity of the economy, from irrigation water for agricultural production to water for hydropower; and priority of use that should be allocated in the following order: drinking water, irrigation, hydropower, ecology, agro-industries and non-agricultural industries, navigation and other uses (National Water Policy 2002: §5; Rajasthan State Water Policy 1999: §8). Domestic uses of water have overriding priority in water allocation. Nevertheless, some policies also provide that this priority list can be changed if circumstances so require, thus ensuring that there is little substance in the prioritization (Maharashtra State Water Policy 2003: §4; Rajasthan State Water Policy 1999: §8).

The policies generally provide that beneficiaries and other stakeholders should be involved from the project planning stage (National Water Policy 2002: §6(8)). The participatory provisions link participation with decentralization, focusing on the need to devolve the control of irrigation systems to users. This is premised on the perceived inability of the state to deliver appropriate benefits to farmers. The basic idea is to transfer part or full control of irrigation systems to users by both allowing and forcing them to maintain and finance irrigation systems and share water among themselves (Uttar Pradesh Water Policy (1999): §17(1)).

The policies generally promote the use of 'incentives' to ensure that water is used 'more efficiently and productively' (Maharashtra State Water Policy 2003: §1(3)). This implies increased private sector involvement in water control and use from planning to development to administration of water resources projects (National Water Policy 2002: §13). Urban water supply is singled out for private sector participation (Rajasthan State Water Policy 1999: §9).

The water policies propose the introduction of water rights. Water rights are not new *per se* and there is a vast corpus of relevant law. The policies restate that the state is the 'sole owner of the water resources' even while they proposing to create water rights in favour of users (Uttar Pradesh Water Policy 1999: §17(1)(d)). These rights are said to be the necessary premise for participation in the 'management' of water resources, for the setting up of water user associations, and for the introduction of trading in entitlements. Trading is specifically proposed in certain policies (Maharashtra State Water Policy 2003: §4(2)).

The policies also introduce wide-ranging legal and institutional reforms, of which three are significant: the introduction of a legal framework for the formation of water user associations to decentralize water governance; the introduction of laws providing for the establishment of a water resources authority whose primary characteristic is to be largely independent from existing irrigation and other water resource departments; and the regulation of groundwater (Karnataka State Water Policy 2002: §7).

10.4.2 Water Sector Reforms in India

National and international influences have influenced broad-ranging 'water sector reforms' carried out partly through projects seeking, for instance, to introduce changes in specific places, such as reforms in water services in specific cities, or in specific activities such as the introduction of participatory management in irrigation. While these reforms are linked to the water policies highlighted above, they were at first often not backed by legislative changes. Over time, there has been an increasing emphasis of regulatory changes to ensure the diffusion of water reforms, their predictability and stability.

While water law reforms are largely state specific, they are similar because they are based on similar national or international policy interventions. First, states like Andhra Pradesh, Rajasthan and Maharashtra foster the participation of farmers in irrigation schemes along the principles of 'participatory irrigation management' (Andhra Pradesh Farmers Management of Irrigation Systems Act 1997; Maharashtra Management of Irrigation Systems by Farmers Act 2005; Rajasthan Farmers' Participation in Management of Irrigation Systems Act 2000). Second, several states, including Andhra Pradesh and Maharashtra have adopted sweeping legislation seeking to restructure the water institutional framework (Andhra Pradesh Water Resources Development Corporation Act 1997; Maharashtra Water Resources Regulatory Authority Act 2005). The rationale for setting up a new water authority is to remove some power from existing water bureaucracies and to ensure that reforms are successfully implemented. Third, several states have now adopted groundwater legislation (see Section 10.3.3).

10.4.3 The River-Linking Project

Recent water sector reforms and accompanying water law reforms will radically change the law and policy framework governing the water sector in India. The mammoth project seeking to link rivers in different basins throughout the country constitutes the single most important development in this area. The rationale for this project is that while some parts of the country are facing water shortages, other parts have excess water (Briscoe & Malik 2006). Inter-basin transfer will seek to export from basins with excess water to basins with water shortage, and will help capture and store rainwater. This project will promote big dam building and coincides with the World Bank view that India still has relatively little capacity to store water and that major investments are required in small and big projects, including large dams.

It was first proposed in August 1980, when the Ministry of Water Resources prepared a National Perspective for Water Development. Two years later, the National Water Development Agency was established to prepare follow-up studies. In 2002, the Supreme Court ordered in a public interest litigation case that the government should complete linking the rivers in India by 2014 (*Writ Petition* (*Civil*) no: 512/2002). This led to the appointment of a Task Force. Based on approvals

from the Technical Advisory Committee and the Planning Commission, as well as on an environmental impact assessment under the Environment Protection Act of 1986, it was decided that such river linking projects could commence. The first Memorandum of Agreement between Uttar Pradesh and Madhya Pradesh was signed in 2005 to link the Ken and Betwa rivers. Proponents of the scheme believe that the river linking project will ultimately have some 30 links between 37 rivers, will include 3,000 storage facilities, will cost up to US$200 billion and could perhaps provide irrigation to 35 million hectares (Bandyopadhyay & Perveen 2002).

Arguments in favour of river inter-linking are better distribution of water, flood protection, and promotion of economic activities in water poor areas (Iyer 2004). The arguments against such interlinkage are that there is never surplus water in a river, it is hugely expensive and not cost effective, will lead to suboptimal use of water resources, and that changed structures of channels may lead to increasing the salt gradient, water loss, seepage and saline pollution of soil in the transporting section (Bandyopadhyay & Perveen 2004; Gupta & van der Zaag 2008).

[Au3] Clear criteria should be met to justify such a transfer (Heyns 2001). While Madhya Pradesh, Haryana, Rajasthan and Tamil Nadu support the scheme, Kerala, Bihar, West Bengal, Assam, Punjab, Chandigarh and Goa oppose it. Some states are conditionally in support. An additional problem is that these rivers are not all national rivers and newspaper articles in Bangladesh have regularly critiqued this unilateral approach. Within India, activists argue that there are major social and ecological shortcomings to the scheme (Patkar 2004). Apart from the specific problems associated with inter-basin transfers, the proposed inter-linking which suggests the building of a number of big dams and canals is also subject to the same criticisms that apply to big dam projects generally (Iyer 2004: 19).

10.5 Conclusions

This historical overview of the evolution of Indian water law reveals how intricately water law is linked not only with the social, religious, and economic developments, but also with the rise and fall of rulers. Yet there are certain common elements. The common elements of water law—property law, the right to water, restrictions on nuisance, penalties, and monitoring systems—can be found in ancient Hindu water law and all subsequent bodies of law. Within these key concepts there may be differences regarding who has ownership, and how rights are acquired, but the basic subject matter of water law has remained relatively constant.

With conquest, the aim of the rulers was to consolidate control, but not necessarily intervene in the lives in the villages and small cities. Thus, the closer one was to the capital, the more it was likely that rights to water and water ownership rules changed to suit the rulers, but there was a coexistence of systems of water rules from the early Hindu times until 1857. It is only as water became vital to trade, transport, agriculture, and industry, that a comprehensive system to control water works was established. And yet, given the vastness of India, the British may have changed the

laws on the books but were not able to change rules and practices at local levels. Thus pluralistic systems of water laws have existed in India over the last 4,000 years. However, changes over the past 150 years have increasingly affected or displaced local rules and institutional arrangements. A great number still remain in place, but every new piece of legislation imposes new changes at the local level.

Since 1857, there has been a steady increase in government intervention in this area. The division of responsibilities between the states and the union initiated in the colonial era gives states primary control over water. Nevertheless, unifying efforts have taken place within national water and environmental policy. In the past decades a new trend promotes the use of government legislation to strengthen control over water use while strengthening the position of private actors. Ongoing water law reforms promise to bring about a completely revamped water law in coming years. These dramatic policy and law reforms together with other initiatives such as the interlinking of rivers seek to provide an answer to the problems identified in the water sector.

It is unlikely that either ongoing water law reforms or the interlinking of rivers will provide comprehensive solutions to existing problems. Indeed, water law reforms are largely limited to changes to the management of the water system and fail, for instance, to effectively address social and human rights. Regarding interlinking and the new reservoirs that it seeks to create, the negative consequences of large dams have already been shown over the past decades. Neither reform strategy is likely to provide an effective answer to existing problems. Further law and policy reforms will thus be required in the future.

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References

Bandyopadhyay, J., & Perveen, S. (2002). *The Interlinking of Indian Rivers: Some Questions on the Scientific, Economic, and environmental Dimensions of the Proposals*. Presented at the Seminar on Interlinking Indian Rivers: Bane or Boon? Kolkata.

Bandyopadhyay, J., & Perveen, S. (2004). Interlinking of rivers in India: Assessing the justifications. *Economic and Political Weekly*, *39*, 5307–5316 (11 December).

Briscoe, J., & Malik, R. P. S. (2006). *India's water economy: Bracing for a turbulent future*. New Delhi: The World Bank.

Cullet, P. (Ed.). (2007). *Sardar Sarovar Dam project: Selected documents*. Aldershot: Ashgate.

Dellapenna, J. W. (2001). The right to consume water under "pure" riparian rights. In R. Beck (Ed.), *Waters and water rights ch. 7*. Newark, NJ: LexisNexis.

Dharmadhikary, S. (2005). *Unravelling Bhakra—assessing the temple of resurgent India*. Badwani: Manthan.

D'Souza, R. (2006). *Interstate disputes over Krishna – law, science and imperialism*. Hyderabad: Orient Longman.

FAO Aquastat (2003). Available at http://www.fao.org/ag/agl/aglw/aqyastat/main/.

Faruqui, N. I. (2001). Islam and water management: Overview and principles. In N. I. Faruqui, A. K. Biswas, & M. J. Bino (Eds.), *Water management in Islam*. Tokyo: United Nations University Press.

Gadgil, M., & Guha, R. (1992). *The use and abuse of nature*. New Delhi: Oxford University Press.

Getzler, J. (2004). *A history of water rights at common law*. Oxford: Oxford University Press.

Gupta, J., & van der Zaag, P. (2008). Interbasin water transfers and integrated water resources management: Where engineering, science and politics interlock. *Physics and Chemistry of the Earth*, *33*, 28–40.

[Au4] Heyns, P. (2002). The interbasin transfer of water between SADC countries: A developmental challenge for the future. In A. R. Turton & R. Henwood (Eds.), *Hydropolitics in the developing world, a southern African perspective* (pp. 157–176). Pretoria: African Water Issues Research Unit.

Iyer R. R. (2004). River-linking project: Many questions. In Medha Patkar (Ed.), *River linking: A millennium folly?* (pp. 9–19). Mumbai: National Alliance of People's Movements.

Kalpakkian, J. (2004). *Identity, conflict and cooperation in international river systems*. Ashgate: Aldershot.

Kautilya (*c*.300 BCE). *The arthashastra* (L. N. Rangarajan, Trans. 1992). Delhi: Penguin Books.

Laws of Manu (*c*.200 BCE). In W. Doniger & B. K. Smith (Eds.). New Delhi: Penguin Books.

Majumdar, R. C., Raychaudhuri, H. C., & Datta, K. (1978). *An Advanced History of India* (4th ed.). Delhi: Macmillan.

Mosse, D. (2003). *The rule of water: Statecraft, ecology and collective action in South India*. New Delhi: Oxford University Press.

Muralidhar, S. (2006). The right to water: An overview of the Indian legal regime. In E. Riedel & P. Rothen (Eds.), *The Human Right to Water* (pp. 65–81). Berlin: Berliner Wissenschafts-Verlag.

Naff, T., & Dellapenna, J. W. (2002). Can there be a confluence? A comparative consideration of western and Islamic fresh water law. *Water Policy*, 4, 465–489.

Patkar, M. (Ed.). (2004). *River linking: A millennium folly*? Mumbai: National Alliance of People's Movements.

Planning Commission (2006). *Rural water supply and sanitation, eleventh five-year plan—approach paper*. New Delhi: Planning Commission.

[Au5] Salman, S. M. A., & Uprety, K. (2003). *Conflict and cooperation on South Asia's international rivers: A legal perspective*. The Hague: Kluwer Law International.

Siddiqui, I. A. (1992). History of water laws in India. In C. Singh (Ed.), *Water law in India* (pp. 289–319). New Delhi: Indian Law Institute.

Singh, C. (1991). *Water rights and principles of water resources management*. Bombay: N.M. Tripathi.

Subedi, S. P. (Ed.). (2005). *International watercourses law for the 21st century—the case of the River Ganges Basin*. Aldershot: Ashgate.

Cases

M.C. Mehta v. Kamal Nath (1997) 1 SCC 388.

Subhash Kumar v. State of Bihar, AIR 1991 SC 420.

Narmada Bachao Andolan v. Union of India, Writ Petition (Civil) No. 319 of 1994, Supreme Court of India, Judgment of 18 October 2000, AIR 2000 SC 3751.

Narmada Water Disputes Tribunal, Final Order and Decision of the Tribunal 1979.

Writ Petition (Civil) No: 512/2002.

Other Government Materials

Andhra Pradesh Farmers Management of Irrigation Systems Act (1997).

Andhra Pradesh Water Resources Development Corporation Act (1997).

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TIME

Monday, Jul. 19, 2010

How India's Success Is Killing Its Holy River

By Jyoti Thottam/Pipola

In a pine-scented Himalayan valley, Sushila Devi is a reluctant soldier in India's new war over water. Her village, Pipola, sits just southeast of the Tehri Dam, which bestrides one of the precursors of the Ganges River and is India's largest hydropower project. Since the dam was completed in 2006, the natural spring that once fed Pipola has dried up. Several times a day, Devi drapes a red sari above her blue eyes, hoists a 2.5-gal. (10 L) brass vessel atop her head and walks to the nearest hand pump. There, she and the other women of Pipola spend two or three hours a day, sometimes more, locked in low-intensity combat. "We have to go to the next village," she says. "Oh, how angry they get. They fight. We wait."

(See TIME's photo-essay "Holy Water: Controversy on the Ganges.")

Like any conflict, this one has its desperate refugees and its frustrated negotiators. Virojini Devi's family is one of several in Pipola that had to give up farming for lack of water. Three months ago, her husband left the village to work in a hotel bakery outside of New Delhi, hoping to earn enough to feed their five children. She scavenges along the rough mountain roads for water while the giant lake created by the dam lies untouched a few hundred meters below on the valley floor. "Something is not right," she says. Roshini Devi, Pipola's elected village *pradhan*, or chief, met with state officials recently to propose pumping water up from the lake. They agreed to the plan but so far have delivered nothing but a twice-daily visit from a water tanker. "It's not a permanent solution," she says.

Battles like the one in Pipola are festering all over India. Taken together, they represent a crisis that affects not just India's deserts but also water-rich areas like the Gangetic Plain, the vast, fertile farmland nourished by the Ganges and its mighty network of tributaries. It's a crisis brought on by India's relentless push to modernize, as water that once sustained small towns and villages is increasingly put in service of big hydroelectric dams, big cities and big agriculture — the engines of economic growth.

(See pictures of the world water crisis.)

Following the Ganges (known as Ganga to Indians) from the Himalayas to Varanasi, 600 miles (965 km) downstream, I saw this tension play out in countless ways. As the villages around the Tehri Dam lose their natural springs, the dam sends drinking water and electricity to Delhi, home to 16 million people. Delhi sucks up not only water but people too — migrants who leave their farms for the city because there isn't enough water to sustain them. The urban areas don't always win, however. Farther downriver, the farms of India's powerful rural heartland divert power and water from small cities like Kanpur. Without enough of either, Kanpur's fight against industrial pollution has become nearly impossible. These competing demands are lowering water levels all along the Ganges, a crisis most apparent in the sacred city of Varanasi. There, a decades-long push to clean up the river is gaining momentum and attracting money, but it may not be enough to correct the miles of mismanagement upstream.

(See pictures of the world's most polluted places.)

The good news is that India's rivers can still be saved. Like the causes of water scarcity, the policies that can correct them are local and could be put in place immediately. "Water is an issue, unlike climate change, about which I'm not at all despondent," says Sunita Narain, one of India's most influential environmentalists. "In spite of the fact that our rivers really need to be cremated, I do believe that we have solutions."

Finding solutions matters not just to those who live along India's riverbanks. If the country fails to keep up with the water needs of its growing cities, those cities will be unable to sustain the robust economic growth that has become a magnet for global investment. Without sensible water policies, political agitation — like the recent controversies over Coca-Cola's use of groundwater in rural communities in southern and western India — will become more frequent and river-sharing negotiations with India's neighbors Pakistan and Bangladesh more tense. To cope with its chronic water shortages, India employs electric groundwater pumps, diesel-powered water tankers and coal-fed power plants. If the country increasingly relies on these energy-intensive short-term fixes, the whole planet's climate will bear the consequences. India is under enormous pressure to develop its economic potential while also protecting its environment — something few, if any, countries have accomplished. What India does with its water will be a test of whether that combination is possible.

See TIME's photo-essay "The Politics of Water in Central Asia."

Dammed and Damned

The Tehri Dam is the grandest fulfillment of Jawaharlal Nehru's hope that dams would be the "temples of modern India." The dam wall is 870 ft. (265 m) high — taller than the Hoover Dam — and when completed, the dam formed a reservoir 47 miles (75 km) long that completely submerged the old town of Tehri. But the dam is also a stark example of how quickly a place with abundant water resources can turn into one plagued by shortage. There are more than 100 villages like Pipola scattered around the reservoir's rim, and they feel

that shortage acutely. The villages can't get water from the lake itself — the walls of the reservoir are the exposed sides of a blasted mountain made of loose gravel too steep to climb — and the construction of the dam has disrupted the underground sources of the area's natural springs. So the residents of Pipola are lobbying Ramesh Pokhriyal, chief minister of Uttarakhand state, for a pumping station. When I met him in Dehra Dun, the state's capital, he insisted that all the affected villages near the Tehri Dam would be helped "in due course of time."

The local water shortage is a minor obstacle to his much larger ambitions for the state. Pokhriyal, known as Nishank ("he who is without doubt"), has a plan to turn Uttarakhand into an investor-friendly, eco-friendly mountain paradise. "Even Switzerland is nothing compared to us," Pokhriyal says. He wants to promote adventure sports, ayurvedic spas, organic food and spiritual tourism, along with heavy industry. Pokhriyal plans to build 10 more dams over the next few years to fund his vision, but there may not be enough water in the area's rivers to fill them: water levels are declining across the state. Uttarakhand rushed to hydropowered development so quickly that it went from a power surplus to a power deficit in just the past two years. Hydropower officials blame climate change; activists blame damage to the rivers' catchment areas. Whatever the cause, the Tehri Dam hasn't come close to delivering the amount of power or water that was expected. On the day I visited, it was running at 25% capacity. To meet demand for power, the dam actually pumps water back upstream and reuses it.

(See pictures of India's turning points.)

Capital Waste

From the Tehri Dam, the Upper Ganga Canal channels clean drinking water 121 miles (194 km) downstream to the nation's capital. Thanks to this bounty and supplies from its own river, the Yamuna, Delhi enjoys a water availability of 66 gal. (250 L) per person per day — comparable to the amount consumed in much of Europe. As Sunita Narain, director of the Centre for Science and the Environment, puts it, "Delhi is a pampered city."

Very few of the city's residents experience that abundance. Delhi loses about half the water it gets to leakage, from both decaying pipes and theft, and what's left isn't evenly distributed. The privileged parts of central Delhi get as much as 132 gal. (500 L) of water per capita per day; others get only 8 gal. (30 L). And so in Delhi, as in Tehri, the poor line up at municipal water tankers and hand pumps. The Sonia Vihar pumping station, which opened in 2006, was meant to ease chronic water shortages by using supplies from the Tehri Dam. But there isn't enough water in the reservoir, and Sonia Vihar has been operating below its expected capacity of 140 million gal. (530 million L) per day for the past two years.

Delhi's water inequity is one of the many widening gaps between rich and poor in this booming city. Another is sanitation. The city's population has exploded by 60% since 1995, but Delhi has failed to invest in underground sewer lines to keep pace. More than 6 million people remain unconnected to any sewer line (mainly because they live in unauthorized housing settlements), and their wastewater flows into open drains. When the Yamuna River leaves Delhi, it is unable to support any but the smallest aquatic life.

See TIME's photo-essay "The Tempestuous Nehru Dynasty of India."

See TIME's India covers.

The capital has spent more than $325 million on river-cleanup schemes, but they have little effect when the city empties 475.5 million gal. (1.8 billion L) of untreated wastewater into the river every day. Delhi's leaders are considering building a new system of sewers, but Narain says raising the price of water is a more urgently needed fix. It would be unpopular, but it would help pay for sewers and give those who have plenty of water an incentive to use less.

Torrent of Toxins

In the 19th century, Kanpur was as important as Delhi. It was a huge garrison town for the British army and then grew into a major producer of leather goods. Kanpur's 400 tanneries still make up its largest industry. The population has grown by 60% since 1990, to more than 3.2 million, making it the biggest city between Delhi and Kolkata. Growth has generated the usual urban ills: traffic, pollution and high real estate prices, plus the special burden of the tanneries: 8 million gal. (30 million L) a day of wastewater contaminated with chromium and other chemical by-products. Like Delhi, Kanpur's wastewater-treatment system is chronically inadequate.

(See more about the world's dirty rivers.)

But unlike the capital, Kanpur does not have clean drinking water delivered from upstream. Instead, two additional canals along the Ganges divert water to farmers in the powerful rural areas, so by the time the river reaches Kanpur, it is already depleted. As a result, Kanpur has the most widespread water poverty of any major Indian city: a third of its residents get by on less than 13 gal. (50 L) per day. The city's leading environmental crusader, Rakesh Jaiswal, is worn out from a two-decade case against tannery pollution. His legal battle with the tanneries resulted in the closure of 127 egregious polluters in 1998. But closing tanneries just pushed them farther downstream, so Jaiswal, 51, has shifted his energy toward getting them to pay for their own wastewater treatment rather than expect the city or state to foot the bill.

Jaiswal has found an unlikely ally in Imran Siddiqui, director of one of Kanpur's oldest and largest tanneries. Super Tannery is in the heart of Kanpur's traditional leather district, called Jajmau. Pony carts still carry hides along the cobblestone streets nearby, but this factory is a huge beneficiary of the global economy. It makes nearly 5,000 pairs of shoes a day for export to the U.S., Europe and Australia, worth $39 million a year. Siddiqui is proud of its success, but he wants to rid his industry of its bad reputation. He recently took 11 other tannery executives on a trip to Italy to show them how that country's 10,000 tanneries thrive despite strict regulations. When their treated wastewater enters the Arno River, Siddiqui says, "it is crystal clear."

Convinced that Kanpur can do the same, he submitted a $76 million proposal to the central government that would include everything from a centralized effluent pipeline to an off-site landfill for recovered chrome. Tanners would pay according to the amount of wastewater they produce, giving them an incentive to use fewer chemicals and less water. "The government has to be strict," he says. Jaiswal should be heartened by this enthusiasm and by the central government's approval of $250 million in water and sewer improvements for the city. But he worries that even if Kanpur cleans up its stretch of the Ganges, it can't increase the amount of water flowing into the city from other, more politically important places upstream. "If things continue as they are," he says, "in the next five years, there will be no Ganga in Kanpur."

An Unholy Mess

By the time the Ganges reaches Varanasi, India's holiest city, the river has been somewhat restored by several tributaries. This influx helps dilute the impact of pollution, and there is enough water to carry boatloads of Hindu pilgrims who come to offer prayers in this temple town of 1.3 million. Even so, water levels have fallen steeply: the Ganges once had an average depth of about 197 ft. (60 m) around Varanasi, but in some places it is now only 33 ft. (10 m). Upstream there are stretches where the Ganges has disappeared completely. The blame, again, goes to Nehru's secular temple. "A significant change happened after Tehri [was built]," says chemical engineer S.N. Upadhyay, one of the first scientists to document the steady decline of the river's health.

See pictures of India's health care crisis.

See how to prevent illness at any age.

The river has its own natural capacity to treat waste: dissolved oxygen in a healthy river digests bacteria. The Hindu belief that the Ganges always remains pure, that it can heal itself, has some basis in science. But the combination of a rising pollution load and falling water levels makes that process much harder. The gap between the amount of sewage produced in Varanasi and the amount treated has steadily widened and now stands at 50 million gal. (189 million L) per day, nearly all of which flows through open drains into the Ganges. Upadhyay is angry that Delhi is being allowed to grow unchecked, to the detriment of every other part of the Ganges River Basin. In the competition between the megacity and the holy city, Upadhyay says, "Delhi is winning, of course."

Ironically, Varanasi's problems with river pollution are finally getting the attention of politicians in the capital. In February, the Indian government committed $4 billion to clean up the Ganges, including funds to build and provide backup power for enough sewage-treatment plants to meet Varanasi's expected needs in 2030. The central government is also funding a pilot project for a series of treatment ponds that use bacteria to digest waste and can be run with minimal power.

(See the top 10 scientific discoveries of 2009.)

Those ponds will be the fulfillment of 28 years of single-minded advocacy by Veer Bhadra Mishra, one of the Ganges' best-known protectors. When he founded the Clean Ganga movement, the solution to Varanasi's problems seemed obvious: build more sewage-treatment plants. That proved to be folly. More than a dozen plants were built but failed to function properly because the electricity supply was unreliable. So Mishra, 72, used his unique credentials — he is the chief priest of the 400-year-old Sankat Mochan temple and a professor of hydraulic engineering at the local university — to push for creative ways to clean the river. "We say that if the river doesn't have water, then the river dies," he says. "And with it, the story of Ganga will be over."

Acknowledging that the Ganges is polluted means believing that it can be polluted, an idea many devout Hindus once refused to accept. But Mishra's influence has changed attitudes. Now people strictly observe the rule against bathing with soap in the river, and there are no longer plastic bags full of marigold offerings floating on its surface. And all along the river, there is a new mantra, "minimum dry-weather flow," as engineers and policymakers have begun to realize that quantity is as important as quality to the river's health.

Not even the devout deny the plight of the Ganges now. But there is another belief in India that is a much greater danger: the notion that economic growth can raise incomes and living standards without limit or consequence. Water may be a renewable resource, but it is not boundless. As rivers and springs are depleted, Indians increasingly rely on groundwater for their household needs; it is already the largest user of groundwater in the world, consuming more than 25% of the global total.

Still, as the new water-management plans in Delhi, Kanpur and Varanasi suggest, all is not lost. India's planners are finally realizing that dams, canals, water taps and sewer lines are as connected to one another as rivers are to the glaciers, rain and groundwater that feed them. About 50 miles (80 km) from the Tehri Dam, I met Ambrish Sharma, executive engineer of a small dam at Dakpathar Barrage and a proponent of this new thinking. Sharma is as passionate about preserving forest cover to recharge the rivers as he is about the need for hydropower. "We should do everything," he says.

He is not willing to give up on dams altogether. Done correctly, hydropower is a clean, renewable source of energy that India has in abundance, and Sharma has seen the alternative. Before coming to Uttarakhand, Sharma worked at a coal-fired plant in the western deserts of Rajasthan. The worst part of the job, he says, was watching the coal. One 250-MW boiler burns more than 150 tons of coal in an hour. "It's good to work in hydropower," he says simply. Sharma finishes this story and smiles as we are served two glasses of water on a tray. "It's untreated water from the Yamuna," he says, the same water that leaves the dam. We drink, and it tastes divine.

See TIME's Pictures of the Week.

The New York Times | http://nyti.ms/1kmlDCt

ASIA PACIFIC | NYT NOW

Poor Sanitation in India May Afflict Well-Fed Children With Malnutrition

By GARDINER HARRIS JULY 13, 2014

SHEOHAR DISTRICT, India — He wore thick black eyeliner to ward off the evil eye, but Vivek, a tiny 1-year-old living in a village of mud huts and diminutive people, had nonetheless fallen victim to India's great scourge of malnutrition.

His parents seemed to be doing all the right things. His mother still breast-fed him. His family had six goats, access to fresh buffalo milk and a hut filled with hundreds of pounds of wheat and potatoes. The economy of the state where he lives has for years grown faster than almost any other. His mother said she fed him as much as he would eat and took him four times to doctors, who diagnosed malnutrition. Just before Vivek was born in this green landscape of small plots and grazing water buffalo near the Nepali border, the family even got electricity.

So why was Vivek malnourished?

It is a question being asked about children across India, where a long economic boom has done little to reduce the vast number of children who are malnourished and stunted, leaving them with mental and physical deficits that will haunt them their entire lives. Now, an emerging body of scientific studies suggest that Vivek and many of the 162 million other children under the age of 5 in the world who are malnourished are suffering less a lack of food than poor sanitation.

Like almost everyone else in their village, Vivek and his family have no toilet, and the district where they live has the highest concentration of people who defecate outdoors. As a result, children are exposed to a bacterial brew that often sickens them, leaving them unable to attain a healthy body weight no matter how much food they eat.

"These children's bodies divert energy and nutrients away from growth and

brain development to prioritize infection-fighting survival," said Jean Humphrey, a professor of human nutrition at Johns Hopkins Bloomberg School of Public Health. "When this happens during the first two years of life, children become stunted. What's particularly disturbing is that the lost height and intelligence are permanent."

Two years ago, Unicef, the World Health Organization and the World Bank released a major report on child malnutrition that focused entirely on a lack of food. Sanitation was not mentioned. Now, Unicef officials and those from other major charitable organizations said in interviews that they believe that poor sanitation may cause more than half of the world's stunting problems.

"Our realization about the connection between stunting and sanitation is just emerging," said Sue Coates, chief of water, sanitation and hygiene at Unicef India. "At this point, it is still just an hypothesis, but it is an incredibly exciting and important one because of its potential impact."

This research has quietly swept through many of the world's nutrition and donor organizations in part because it resolves a great mystery: Why are Indian children so much more malnourished than their poorer counterparts in sub-Saharan Africa?

A child raised in India is far more likely to be malnourished than one from the Democratic Republic of Congo, Zimbabwe or Somalia, the planet's poorest countries. Stunting affects 65 million Indian children under the age of 5, including a third of children from the country's richest families.

This disconnect between wealth and malnutrition is so striking that economists have concluded that economic growth does almost nothing to reduce malnutrition.

Half of India's population, or at least 620 million people, defecate outdoors. And while this share has declined slightly in the past decade, an analysis of census data shows that rapid population growth has meant that most Indians are being exposed to more human waste than ever before.

In Sheohar, for instance, a toilet-building program between 2001 and 2011 decreased the share of households without toilets to 80 percent from 87 percent, but population growth meant that exposure to human waste rose by half.

"The difference in average height between Indian and African children can be explained entirely by differing concentrations of open defecation," said Dean

Spears, an economist at the Delhi School of Economics. “There are far more people defecating outside in India more closely to one another’s children and homes than there are in Africa or anywhere else in the world.”

Not only does stunting contribute to the deaths of a million children under the age of 5 each year, but those who survive suffer cognitive deficits and are poorer and sicker than children not affected by stunting. They also may face increased risks for adult illnesses like diabetes, heart attacks and strokes.

“India’s stunting problem represents the largest loss of human potential in any country in history, and it affects 20 times more people in India alone than H.I.V./AIDS does around the world,” said Ramanan Laxminarayan, vice president for research and policy at the Public Health Foundation of India.

India is an increasingly risky place to raise children. The country’s sanitation and air quality are among the worst in the world. Parasitic diseases and infections like tuberculosis, often linked with poor sanitation, are most common in India. More than one in four newborn deaths occur in India.

Open defecation has long been an issue in India. Some ancient Hindu texts advised people to relieve themselves far from home, a practice that Gandhi sought to curb.

“The cause of many of our diseases is the condition of our lavatories and our bad habit of disposing of excreta anywhere and everywhere,” Gandhi wrote in 1925.

Other developing countries have made huge strides in improving sanitation. Just 1 percent of Chinese and 3 percent of Bangladeshis relieve themselves outside compared with half of Indians. Attitudes may be just as important as access to toilets. Constructing and maintaining tens of millions of toilets in India would cost untold billions, a price many voters see no need to pay — a recent survey found that many people prefer going to the bathroom outside.

Few rural households build the sort of inexpensive latrines that have all but eliminated outdoor waste in neighboring Bangladesh.

One analysis found that government spending on toilets pays for itself in increased tax receipts from greater productivity, but the math works only if every member of a family who gets a toilet uses it.

“We need a cultural revolution in this country to completely change people’s attitudes toward sanitation and hygiene,” said Jairam Ramesh, an economist and

former sanitation minister.

India's government has for decades tried to resolve the country's stubborn malnutrition problems by distributing vast stores of subsidized food. But more and better food has largely failed to reverse early stunting, studies have repeatedly shown.

India now spends about $26 billion annually on food and jobs programs, and less than $400 million on improving sanitation — a ratio of more than 60 to 1.

"We need to reverse that ratio entirely," Dr. Laxminarayan said.

Lack of food is still an important contributor to malnutrition for some children, and some researchers say the field's sudden embrace of sanitation has been overdone. "In South Asia, a more important factor driving stunting is diet quality," said Zulfiqar A. Bhutta, a director of the Center for Global Child Health at the Hospital for Sick Children in Toronto.

Studies are underway in Bangladesh, Kenya and Zimbabwe to assess the share of stunting attributable to poor sanitation. "Is it 50 percent? Ninety percent? That's a question worth answering," said Dr. Stephen Luby, a professor of medicine at Stanford University who is overseeing a trial in Bangladesh that is expected to report its results in 2016. "In the meantime, I think we can all agree that it's not a good idea to raise children surrounded by poop."

Better sanitation in the West during the 19th and early 20th centuries led to huge improvements in health long before the advent of vaccines and antibiotics, and researchers have long known that childhood environments play a crucial role in child death and adult height.

The present research on gut diseases in children has focused on a condition resulting from repeated bacterial infections that flatten intestinal linings, reducing by a third the ability to absorb nutrients. A recent study of starving children found that they lacked the crucial gut bacteria needed to digest food.

In a little-discussed but surprising finding, Muslim children in India are 17 percent more likely to survive infancy than Hindus, even though Muslims are generally poorer and less educated. This enormous difference in infant mortality is explained by the fact that Muslims are far more likely to use latrines and live next to others also using latrines, a recent analysis found.

So widespread housing discrimination that confines many Muslims to separate slums may protect their children from increased exposure to the higher

levels of waste in Hindu communities and, as a result, save thousands of Indian Muslim babies from death each year.

Just building more toilets, however, may not be enough to save India's children.

Phool Mati lives in a neighborhood in Varanasi with 12 public toilets, but her 1-year-old grandson, Sandeep, is nonetheless severely malnourished. His mother tries to feed him lentils, milk and other foods as often as she can, but Sandeep is rarely hungry because he is so often sick, Ms. Mati said.

"We all use the bathroom," she said.

The effluent pipe that served the bathroom building is often clogged. Raw sewage seeps into an adjoining Hindu temple, and, during the monsoon season, it flooded the neighborhood's homes. The matron of the toilet facility charges two rupees for each use, so most children relieve themselves directly into open drains that run along a central walkway.

No Indian city has a comprehensive waste treatment system, and most Indian rivers are open sewers as a result. But Varanasi, India's oldest and holiest city, is so awash in human waste that its decrepit condition became a national issue in recent elections. The city's sewage plants can handle only about 20 percent of the sewage generated in the city, said Ramesh Chopra of Ganga Seva Abhiyanam, a trust for cleaning the river. The rest sloshes into the Ganges or fetid ponds and pits.

Millions of pilgrims bathe in the Ganges along Varanasi's ancient riverfront, but a stream of human waste — nearly 75 million liters per day — flows directly into the river just above the bathing ghats, steps leading down to the river. Many people wash or brush their teeth beside smaller sewage outlets.

Much of the city's drinking water comes from the river, and half of Indian households drink from contaminated supplies.

"India's problems are bigger than just open defecation and a lack of toilets," Dr. Laxminarayan said.

Suhasini Raj contributed reporting.

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