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Hydro-diversity: A Waterscape Model of the Medieval Western Indian City

Sara Keller

Abstract

In monsoon-dependent South Asia, harvesting and managing water is a necessity. Thus, monuments and modified landscapes related to irrigation, water storing and water worship represent a large share of Indian architectural heritage. Yet, this rich corpus and its attached hydrological knowledge awaits full recognition: thus far, documentation and studies focus on the most visible elements, especially stepwells, tanks and other dug facilities. Hydro-structures are generally considered in an isolated manner and lack contextualisation. Following the observations of English chaplain Edward Terry (1590–1660), this paper aims to explore the relationship between the medieval Indian city and the presence of monumental, often religiously connoted, hydraulic constructions. Based on archaeological and historical data, the paper proposes a fresh look at the hydraulic elements in the larger context of the city. The main argument rehabilitates the artificial lake and underlines its crucial function in plain regions that depend on a sufficient refilling of aquifers. In Western India, the typical city of the Solanki and later the Vaghela and the Muzaffarid dynasties had access to a broad variety of water sources capable of meeting the needs of multiple religious and secular activities (hydro-diversity). This generous waterscape and its multifaceted developments reflect on functions of sociability and religiosity in the city. Water here appears as an essential identity marker of urbanity.

Keywords: India, archaeology, history, Solanki, city, water, aquifers, lake, well, waterscape

> These great receptacles of water are made near places that are very populous.
>
> (Edward Terry 1655: 187–8)

Water – and this is not unique to the Indian subcontinent – is an element that is hard to grasp both physically and intellectually. Thus, it has always been perceived with a great deal of ambivalence. The ultimate provider of life, water also proves a terrible threat on the micro and macro-level. It is not just that history abounds with examples of flourishing civilisations suffering terrible

Sara Keller, Max Weber Centre for Advanced Cultural and Social Studies, University of Erfurt, Erfurt, Germany; sara.keller@uni-erfurt.de. Many thanks go to the Deutsche Forschungsgesellschaft (DFG, German Research Foundation), which funded this research under the grant number FOR2779.

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setbacks due to water scarcity, floods or tsunamis (Chew 2005, Guo 2016), but current events also show that modern societies empowered with advanced technologies struggle to provide adequate water solutions. Water as an overwhelming force of nature has been personified in the form of powerful deities capable of providing both life and death, while diverse religions and traditions share practices aimed at taming terrifying water deities, and at gaining favour in the form of an abundant water supply or limits to flooding. In the Indian subcontinent, regional rituals address Varuna,[1] the God of sky and water, mother-goddesses[2] and river-goddesses such as Gangā or Sarasvatī (Prasad 2017), or *yakṣas*, *nāgas*, *devas* and other local deities and spirits (Samuel 2008: 201; Coomaraswamy 1971) in order to attract rain, thank a generous well or stop diluvian rainfall. These practices are particularly visible in arid regions that are prone to water shortages and excessive floods.

In settlements, especially in dense urban contexts, this ambivalent relationship to water translates into complex topographies, constructions and modified landscapes. A successful settlement must provide easy access to water, yet protect the inhabited space from excessive water volumes. To address this difficult challenge, cities would modify the primary land-water margins in order to create clearly defined and controllable water boundaries. In South Asia, so-called *bhūmi* or foundation laying ceremonies (*jalagarbha* and *śilānyāsa*)[3] accompanied such works to appease deities and ensure the success of the enterprise (Acharya 1946: 185; Dagens 1970: 138, 224). Consequently, water works represented one of the major collective efforts towards the shaping of the urban space. Defining the course of the water, sometimes diverting the main branch or part of a river, stabilising river banks, sanitising marshes and wet areas, and facilitating the channelling of runoff and wastewater are amongst the colossal works undertaken by early South Asian societies (as in the Western world, as well; see Leguay 2002) in order to establish the foundation of a shared living space.

For this reason, the waterscape of today's cities hardly reflects the original terrain: on the contrary, it is the result of monumental efforts and recurrent renovations, changes and developments towards the shaping of complex topographies. In addition to the substantial levelling and earthworks no longer visible today, water is manifested, sometimes presented, in the form of monumental constructions such as ditches, modified river banks (docks or steps), river bridging facilities, bathing places, wells and ponds. These built structures represent a large corpus of land/water boundaries that form the first defining

1 And fertility gods like Vishnu and Nārāyan.

2 Jain Neubauer mentions the mother-goddess Vārudi worshipped for fertility in water sites in Gujarat (Jain Neubauer 1981: 6). For *yakṣas*, see Samuel 2008: 101 and Coomaraswamy 1971.

3 On foundation rituals, see *vāstu śāstric* literature such as the *Mānasāra* or the *Mayamatā* (Acharya 1946: 185; Dagens 1970: 138, 224).

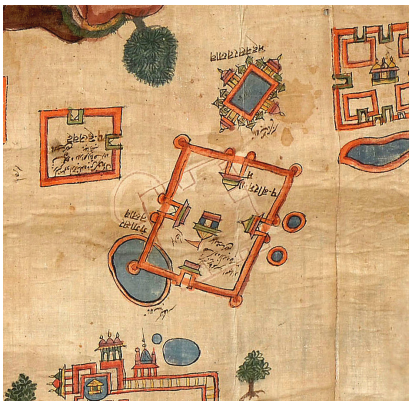

Figure 1: Viramgam with its artificial lakes Munsar and Gangasar. Detail of the 18th century cloth map

element of the urban geography. This is particularly obvious in cartographic documents and geographic imaginaries whereas the river represents an essential landmark that defines the orientation of the site. Water visually but also symbolically shapes the urban body. Ancient maps of Western India are explicit about water as an identity and orientation marker of a place (see Figure 1 and Gole 1976). In South Asia, access to water is conditioned by seasonal rains caused by the monsoon and its particular binary climatic characteristics. The recharge of aquifers and runoff takes place only once a year, roughly from June to September, and is accompanied by heavy floods in low-lying lands and river neighbourhoods. This flooding, dramatic if associated with housing or industrial activities, also guarantees the fertility of the land. Natural ponds and manmade facilities allow the population to store and access rain, runoff and aquifer water during the dry season. Archaeological surveys have shown that South Asian societies developed over time a large array of water structures to ensure primarily land irrigation, but also industrial activities (such as cloth dyeing), domestic use and recreation.[4]

Water-related architecture is multifaceted, yet it shares a common sensatory atmosphere: hydro-spaces awaken the senses and trigger a respectful, if not devotional, impetus. The artistic and iconographic programme of pre-modern water structures is often loaded with religious references, reflecting their religious dimension. The monumentality of South Asian hydro-structures also needs to be acknowledged. Medieval[5] stepwells, reservoirs, *kuṇḍas* (tanks) and *ghāt*s (a series of steps leading to a body of water) compete in size and architectural complexity with the palaces, temples and mosques of their time. Their construction required significant resources. The English chaplain Edward Terry noted that:

> Amongst their building, I must take special notice of their wells and tanks, upon both which in very many places they bestow exceeding much cost in stone work. (Terry 1655: 187)

To this day, the monumentality, the richness of the artistic expression and the vibrancy of water-related practices showcase a majestic historical waterscape.

4 See, amongst a rich bibliography, Siddiqui 1986 and Habib 1992 on irrigation; Shokoohy / Shokoohy 2003 and Morelle 2014 on wells, stepwells, hydraulic facilities of forts; Koch 1997 and Brahmbhatt 1986 on garden installations; Agarwal / Narain 1997, Welch 1996, Wescoat 1985, Mishra 2001 on private water facilities, reservoirs and water systems; and the encyclopaedic publications by Jain-Neubauer 1981 and Livingston 2002 on the stepwells of Gujarat.

5 The periodisation of Indian history is still being debated. The term "medieval" refers, in this paper, to the post-Gupta period, and "modern" to the colonial and post-colonial phase.

Beside this visible architecture, minor hydraulic structures, buildings with less obvious artistic or historical significance, and untouched water bodies[6] remain largely unexplored. The latter, however, represent a larger share of water resources, especially in the urban context.

In Ahmedabad, the historical capital of Gujarat, for instance, it is notable that the hydraulic monuments listed by the Archaeological Survey of India (ASI) make up less than 20 per cent of the total surface of water bodies dating back to the pre-colonial period.[7] It is therefore urgent to update archaeological surveys and methodological perspectives in order to grasp the significance of a plural waterscape in the pre-modern Indian city. With this agenda in mind, this paper aims to rehabilitate the importance of forgotten urban waterscapes, especially lakes, ponds and seasonal untouched water bodies,[8] that often represent the most important urban water resources in terms of surface and quantity. This approach to water and the city demonstrates the connectivity of hydraulic structures, which invite us to reconsider water and past water agendas at the city level. Epigraphical documents and archaeological remains give the illusion of wells, stepwells, ponds and reservoirs being isolated elements, constructed by donors bound to a particular territory. Yet, a detailed look at peripheral sources will show the coherence and inter-connectivity of these different structures. I argue that this connectivity speaks for the existence of a hydro-intelligence and the vibrancy of engineering knowledge, much before the introduction of Persian hydrological knowledge in the late sixteenth–early seventeenth century (Keller 2021).[9]

The following analysis focuses on the Western Indian city developed in the framework of the third urbanisation phase (Samuel 2008) that generated the canvas of today's urban Gujarat. Focusing on the Solanki (c. 940–c. 1244) and the Muzaffarid (c.1407–1573), two prolific building dynasties, the discussion covers a long, yet coherent period. The archaeological surveys and historical methodologies presented reveal elements of continuity in the pre-Mughal urban hydro-scheme.

6 I use the term "untouched" for natural water bodies that have not been subject to major water works such as digging, levelling and architectural additions. By contrast, a "built lake" is a lake that has been dug and equipped with accessing constructions (*ghāt*s, shrines, access ramps, sluices, etc.). A built lake might have been dug at the site of a pre-existing untouched water body.

7 Amongst the ASI list of "Monuments of National Importance" in and around Ahmedabad, only five items are water-related structures: Dada Harir Stepwell (N-GJ-18), Mata Bhavani's Stepwell (N-GJ-23), Inlet to Kankaria Lake (N-GJ-38), Jethabhai's Stepwell (N-GJ-45) and the Great Tank, Palace and Harem at Sarkhej Roza (N-GJ-49).

8 The seasonality of post-monsoon ponds also worked against their visibility.

9 Also see the introduction of other Persian hydrological techniques, such as the *qanat* in Deccan and along the South Western Indian coast (Rotzer 1984: 137, Rotzer 2012).

The human as infrastructure

Besides stepwells, temple reservoirs and other remarkable modified waterscapes, Mughal and pre-Mughal accounts testify the extent to which river water, ditches, natural ponds and other undisturbed waterscapes were called upon in both rural and urban contexts. Lake shores and river banks attracted an intense hustle and bustle from sunrise to sunset – a scene that can still be witnessed in many parts of India today (Figure 2). While some urban actors drew water for remote usages (irrigation, domestic use, etc.), water was also used in situ for cleaning activities, including personal hygiene, laundry or industrial works. One of the striking scenes of the river bank was the early morning rituals and baths, activities that were performed with great moral freedom, in the eye of foreign travellers (see Figure 3 and Figure 4). European accounts emphasise the amount of water used for personal hygiene and the recurrence of ablutions:

> Wheresoever they dwell they have orchards and fruit-gardens and many water-tanks, wherein they bathe twice every day, both men and women; and they say when they have finished bathing that they are clear of as many sins as they have committed up to that hour. (Duarte Barbosa Volume 1: 112–113)

Regular bath, laundry and ritual ablutions sometimes shared the same or similar open waterscapes, leading to confusion, in foreign accounts, between the profane and the sacred. French doctor Charles Dellon, visiting Surat in the early seventeenth century, noticed that not everyone bathed outdoors:

> On ne peut rien voir de plus propre que leurs personnes, les riches se lavent chez elles, & les autres à la rivière depuis la naissance du jour jusqu'à la nuit. (Dellon 1699: 74)

Apart from social etiquette, the commitment to cleanliness prevented members of wealthy and educated families from bathing openly in rivers. In the big cities, especially in port towns, the river water was brackish because of proximity to the sea (Sharma 2009: 72) and to urban activities. City inhabitants were also aware of the high level of river pollution due to organic and chemical discharge from artisanal activities such as cloth manufacturing, dyeing activities or leather work.[10] Despite their sacredness, Indian rivers proved highly affected by human activities, especially urban settlements, which used running

Figure 2:
*Ghāt*s of the Munsar lake at Viramgam

10 "Ce fut luy qui nous avertit de ne point boire de l'eau du Gange qui nous donneroit le cours de ventre, mais de boire plûtost de l'eau de puits. " (Tavernier 1679 II: 66–67)

Figure 3:
Women and children bathing in a *kuṇḍa* in the kingdom of Cambay

(*Codice Casanatense* 1540)[11]

water for cleaning and waste drainage. The religious beliefs and practices involving water sometimes clashed with the lack of sanitation, as is still the case today. In 1665, Jean-Baptiste Tavernier observed in Varanasi that the impossibility of bathing in the Gangā resulted in a religious dilemma:

> Ceux qui ne se lavent que dans leur logis (car ils sont tous obligez de se laver avant que de pouvoir manger, & mesme avant que de faire leur cuisine) ceux-là, dis-je, qui n'ont lavé leurs corps que dans de l'eau de leurs puits, ou que l'on est allé quérir à la rivière, ne sont pas assez bien purifiez. (Tavernier 1679 II: 365)

If the classic Sanskrit literature associated religious purity and physical cleanliness, historical accounts are more nuanced (Angermeier 2020: 214). Discussing the concept of water purity in South Asia and its evolution exceeds the scope of this paper: For now, it is enough to note that rivers and other untouched waterscapes were heavily called upon by non-privileged populations that had no means of accessing clean water.

Wealthier inhabitants had their own facilities and their residences were supplied by water carriers. According to the chronicle *Mirāt-i Sikandarī* (p. 84), the nobleman Malik Ayaz, governor of Diu in the early sixteenth century, had a thousand water-carriers in his residential complex. Water was transported in jugs, *chirikkas* or leather bags[12] and carts that required ramps to be built to reservoirs (stone ramps are still visible in several medieval reservoirs). During the medieval and early modern period, servants and appointed water carriers were in charge of transporting water for domestic use. Medieval documents such as the "Slave Deeds" in the twelfth century *Lekhapaddhati*, a collection of administration documents, show that slave women were also given the task

11 Miniature painting number 55 from the "Album di disegni, illustranti usi e costumi dei popoli d'Asia e d'Africa con brevi dichiarazioni in lingua portoghese" known as the *Codice Casanatense* 1540 (Biblioteca Casanatense: Ms.1889 c.55).

of carrying water under the Solanki dynasty (Bano 2004: 314). The recurrent references to water-carriers in Mughal and pre-Mughal accounts correspond with the lack of archaeological references to hydraulic infrastructures. While Harappan cities were equipped with clay pipes and water drains (Kenoyer 1991, Jansen 1989), medieval cities of Western India seem to largely lack such systems.[13] Structures such as stepwells were common, whereas physical hydraulic infrastructures were practically non-existent.[14] The source of water and the site of usage were connected with a human link.

This observation has immense social consequences, since accessing water created a significant work load. Collecting and supplying water absorbed a great deal of daily effort, as is sometimes still the case today, keeping servants, housewives and other women busy and in positions of insecurity (O'Leary 2019, George 2016). In fact, this raises the question of technological development: Could the need to keep an abundant labour force busy with petty tasks such as carrying water explain the slow development of infrastructure? Moreover, this inflation of water accessing activities translated into clear social boundaries between urban actors who benefitted from the access to clean and sufficient water, on the one hand, and water workers, servants and housewives dependent on the generosity of their patrons or relying on untouched water bodies of doubtful purity/cleanliness.

Hydro-diversity

The private underground cistern, or *tankā*, developed from the seventeenth century onwards, allowed individual housing to obtain some degree of autonomy (Keller 2021). In this sense, such a system contributed to a certain democratisation of water access.[15] Before this period, the urban population largely relied on untouched water bodies or access structures donated by the wealthy. Epigraphic documents show that well donations were common acts of philanthropy, territorial control and devotion.[16] By constructing a well or a stepwell,

13 Ancient cities such as those of the Gupta empire seem to have had sophisticated water systems as well, which might have declined during the period of the sometimes-called "urban decay" (Singh et al. 2020; Sharma 1987). Medieval cities, in contrast, seem to have been poorly equipped with aqueducts and drainage, although isolated evidence shows that some ablution tanks and gardens were supplied with water by stone channels (Keller 2023: 156).

14 Evidences of canals and water channels, like those of the Sahasraliṅga lake (12th century), indicate only the supplying of specific facilities or places (also see the canals in Mughal Delhi, Ataullah 2006–7). We have very poor evidence of South Asian urban neighbourhoods or private housing being supplied and/or drained by water channels. For earthenware drain-pipes in early Ujjain and Taxila, see Fardin et al. 2013: 721).

15 Also see Keller (forthcoming).

16 I recorded 34 inscriptions (see Appendix 1) dating from 1082 to the early 20th century, most of the epigraphical documents going back to the Sultanate and pre-sultanate periods, including 11 inscriptions during the Solanki-Vaghela and Delhi Sultanate period (1082–1389) and 17 from the Sultanate period (1405–1560).

the donor, a courtier or a wealthy merchant, provided fresh water to the inhabitants of a territory or the members of a particular community (Jain-Neubauer 1981: xiv; Livingston 2002). Kingship was a factor in these infrastructural activities through numerous, often monumental, donations (*dāna*) of water structures such as stepwells and masonry tanks. Yet donations remained personal deeds and not state decisions. The maintenance and administration of these constructions was handed over to a community, an individual or a particular body. Constructed water structures provided water but also implied social segregation, since access to them was restricted to kin or high castes, as noted by Charles Dellon:

> Ceux des lignées les plus élevées n'ont aucun commerce avec leurs inférieurs [...] & cette rigidité s'étend jusques à ne pas prendre de l'eau dans les mêmes puits. Les étangs sont aussi distinguez, chacun a les siens pour se purifier, & il n'y a que les rivières communes. (Dellon 1699: 129)

Water grading was thus an essential marker of social inclusion/exclusion. Historical references (especially chronicles like the *Mirāt-i Ahmadī* and the *Mirāt-i Sikandarī*) and traveller accounts abound with descriptions and anecdotes that underline the multiplicity of urban resources, their hierarchy and their alternative use, such as the observation that "there were several categories and grades of water having differing levels of purity and utility" (Sharma 2009: 72).

However, social status did not simply translate into an ability to access water from a particular site. Instead, urban water was available in a large variety of quality levels and locations, and individuals developed complex and dynamic systems of accessing water. Each hydro-environment was associated with a certain quality and thus a particular purpose, depending on the origin of water (runoff/ground water), the supply technology (such as well, canal or filtering system) and the maintenance scheme (social status of the institution/person in charge, actual maintenance activities, provision of ritual service).

The inhabitants tapped into different access points for different purposes: rainwater with its low mineral content was preferred for drinking and cooking purposes, river or temple tank water was adequate for rituals, grey water (waste water from bathing and laundry) was avoided, if possible. The hierarchy of water was determined by purity/pollution parameters borrowed from the religious Brahmanical substrate. Thus, water use cannot be reduced to a geographical factor (one uses the closest available water access point), but forms complex constellations of alternative usage, depending on functionality as much as on geographical, social (community belonging), religious and financial factors.[17]

Unlike today's model of the tap, water in the pre-modern urban context is a multi-layered issue based on the multiplicity of usages, users, facilities, places

17 Contemporary alternative water usage perpetuates this long tradition of differentiating water and adapting the water source to usage (author's interviews in Ahmedabad in 2013 and 2014; conversation with water engineer Akil Amiraly on 23 September 2019).

and times. It is dominated by individual initiatives (donations and later private infrastructures) resulting in the organic growth of an uncoordinated set of water structures, apparently lacking global planning.[18] However, a detailed comparative analysis of early urban water structures suggests the coherence of hydraulic elements.

Well and tank

In contrast to hilly regions and other geological configurations that favour runoff, the large alluvial plains of Gujarat have been equipped with numerous wells. To reach a fair picture of the hydraulic structures tapping into ground water, a great number of wells dug in rural and urban areas should be added to the detailed survey of stepwells done by Jutta Jain-Neubauer and Morna Livingston. Villages and rural areas, as well as most of the urban neighbourhoods (*pols*) had their own wells,[19] though many of these underground structures were later filled in during the course of post-independence urban development. Maintenance and common usage of the well appeared to have been one of the important issues managed by the *pol pañcāyat*, or urban neighbourhood council. Mughal and pre-Mughal accounts contain recurrent mentions of wells, which seemed to be a common element of the urban landscape (*Mirāt-i Ahmadī* Supplement 22).

This abundance of wells[20] attests to the accessibility of ground water. In the case of alluvial plains, wells rely on aquifers, rather than on underground streams and rivers. Layers of rock and soil act as a porous material capable of storing a great amount of water in their spaces and cracks. The boundary between the ground saturated with water and the unsaturated ground is referred to as the water table. Wells bored deeper than the water table are automatically filled by the water surrounding them. Aquifer wells therefore benefit from the proximity of water sources that ensure that the underground aquifer remains supplied with water, as David Hardiman notes in a reference to reservoirs:

> Reservoirs – "talav" were important not only for direct irrigation, but also because they allowed water to percolate into the soil and top up surrounding wells. (Hardiman 1998: 1535)

18 Early modern examples of a planned city such as Jaipur instead show that water did become part of urban planning in later periods.

19 "These in terms of a gate with community control, a religious place and a bird-feeder and a community well were constituents of the self-sufficient settlement of 'pol'" (Historic City of Ahmedabad, Nomination Dossier for Inscription on the World Heritage List, AMC 2016, p. 4).

20 Also brought to light by R. P. Masani's ethnographic work on water-worship (Masani 1918: 48).

Figure 4: *Kuṇḍa* of the Sūrya temple near Modhera

Figure 5: Sluices and tank at Dholka

The primary reason for a water-table well to run dry is its inability to reach the level of water in the aquifer when the water table has fallen because of overuse. Thus, the vicinities of rivers, lakes and ditches, potential suppliers of aquifers, are ideal spots to bore a successful well.

During my fieldwork in Gujarat, I recurrently observed the presence of wells near tanks and lakes, a combination that might come as a surprise, since large tanks seem, at first sight, to be a sufficient water source. Why put additional efforts into building a well or stepwell after investing immense resources in digging and building a reservoir like the Sahasraliṅga lake near Patan or the 25 ha Kankaria lake near Ahmedabad?

To name but a few examples of such well-and-tank constellations, we could mention the grand Rāṇī *vāv* ("stepwell") of the late eleventh century, built in the vicinity of the Sahasraliṅga lake. It was donated by Jayasimha Siddharaj, who reigned from 1092 to 1142 AD. Another example is the Bai Hahir vāv from the year 1499, located near the Asarwa lake outside Ahmedabad city. Jutta Jain-Neubauer surveyed a stepwell next to the *kuṇḍa* of the Modhera sun temple (Figure 4; Jain-Neubauer 1981: 57). A quite eloquent example is the Kundvav of Kapadwanj, a square steptank estimated to be from the time of the Solanki king Jayasimha Siddharaj. A well is associated with the tank, showing that the tank and well were planned and constructed together (Burgess / Cousens 1897: LXXXI-II).

Unfortunately, until now no reservoir inscriptions has been found and documented in Gujarat, so that our archaeological findings cannot be enriched by epigraphical material. In a much later period, however, an account from the

Mirāt-i Ahmadī shows that contemporaries of the chronicle were aware about the benefits of building a well near a water source. The Panch Kuwa, or "Five Wells",[21] built near the fortification of Ahmedabad is mentioned twice. The account underlines that the stepwell was always sufficiently filled because of its proximity to the rampart moat:

> It was in this year that Vajeram peshkar of Najm-ud dawlah founded a step-well for comfort and wellfare of God's creatures between the Jamalpur gate and the wall gate where also like the Panch Koh [Kuwa] there was plenty of water in the wells due to vicinity of water of the ditch. (*Mirāt-i Ahmadī*: 613)

In this case, the wells are kept supplied by the moat filled with water from the Sabarmati river. While the lake, river or moat water might be stagnant and brackish, or disqualified by other pollutants, the well water would remain much clearer due to the aquifers acting as a mineral filter. Similarly, the octagonal silt tank on the West side of the Munsar lake, built in 1090 in Viramgam, filters the water entering into the *talao* ("pond"; Keller 2022). This ingenious architectural detail speaks for the engineering skill and capable hydrological knowledge of the Solanki builders. The reigns of the Solanki kings are indeed remembered for a remarkable architectural revival, with particularly extensive inputs in the field of water architecture. This period coincides with the writing of scientific texts such as the *Aparajitaprchha*, an architectural treatise describing means of irrigation and water supply (Dubey 1950: 464–465). Further scientific works from early periods, such as the *Vrhat Sanhita*, or *Bṛhatsamhitā* (6th century), contain climatological and hydrological descriptions that demonstrate the contemporary knowledge of water cycles, rainfall measurement, underground water, exploration of underground water, etc. (see Jain et al. 2007).[22]

> The Vrhat Sanhita and Mayuracitraka by Varahamihira are two very important treatises which are replete with climatological and meteorological information, although they abound in astrological guesses, they contain sufficient scientific facts also. (Jain et al. 2007: 61)

The Yavanarajya inscription, situated in the region of Mathura and dated to the first century BCE, mentions the donation of a well and a tank, which speaks for an early knowledge about the beneficial combination of tank and well (Fussman 1993). Thus the Solanki architecture, and later that of the Sultanate, ostensibly benefitted from the continuity or resurgence of early hydrological knowledge. Unfortunately, the latter has been forgotten in the course of modern urbanisation and the development of the piping system, which has also focused more on avoiding floods, filling up lakes and ponds for urbanisation purposes and using deep bore wells – choices with potentially problematic consequences.

21 Panch Kuwa is today the name of one L-shaped stepwell and the urban area around it in the north-east part of Ahmedabad's walled city.

22 On *dakārgala*, the art of exploring underground water, see Shastri 1969: 500–503.

Lake chain and city orientation

This association between tank and well allows us to look at the lake from a different perspective. The natural or *ghāt*-ed lake, tank or *talao* was pluri-functional: it served not only as a direct water source for bathing, agriculture and domestic purposes, but also ensured the recharge of aquifers and balanced overflow during the rainy season. This explains the role of the sluices (Figure 5), which had to be opened and closed strategically in order to regulate the water flow – excessive water during the rainy season, scarce water during the summer (Hardiman 1998: 1536).

A medieval city had several reservoirs, including, in some cases, a tank within the rampart. The city of Viramgam, for instance, had, according to historical records, two large reservoirs: the Munsar lake, commissioned around 1090 by the mother of the Solanki king Jayasimha Siddharaj (Figures 1, 2 and 6), and the Gangasar lake built during the thirteenth century by Hazrat Alauddin Shah Chishti, part of which is located within the city wall (in the South-East corner, see Figure 6). The eighteenth-century cloth map of the Baroda Museum and Picture Gallery mentions two further round reservoirs, perhaps referring to some of the artificial lakes located today on the north side of the city (Keller 2023: 43). The GIS mapping of Viramgam topography and archaeological remains show that the city was surrounded by a chain of such water bodies, starting with the Munsar lake, the ritual and purest lake (Figure 6, Keller 2022). The city lakes usually bordered the main roads reaching the town and were thus easily accessible from the city gate. As a result, an ensemble of water bodies, untouched or *ghāt*-ed, formed a large blue belt around the city. The walled city often had a reservoir of smaller size, usually associated with a temple or a major shrine. Such tanks, or *kuṇḍas*, were generally not recharged artificially.

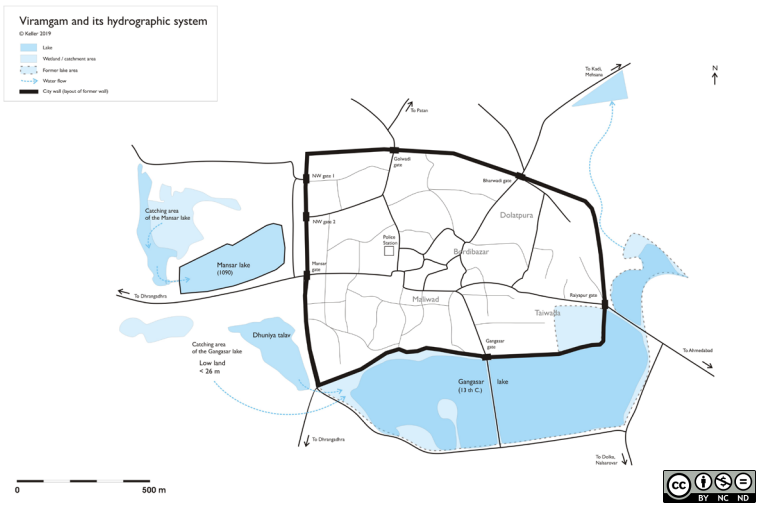

Figure 6:
Viramgam and its hydrological system
compiled by Sara Keller

They must therefore have been dug in an adequate geological environment, enabling them to be refilled by underground springs. *Panikals* and other water diviners were summoned to locate such spots (see Masani 1918: 103–104). Treatises like the *Brhatsamhita* show that the art of finding underground water sources was known since early periods:

> [Varāhamihira] calls this art *dakārgala* or *udakārgala* which term evidently refers to the determination of the subsoil water (*udaka*, *daka*) with the help of a wooden stick (*argala*). (Shastri 1969: 500)

Since temple *kuṇḍas* were dedicated to ritual bathing, no non-religious activities took place there.

The religiously charged hydro-structures – characterised by iconography, presence of shrines and ritualistic elements – can be identified as ritual lakes and tanks. Yet many of them have been desacralised and are now used for profane and polluting activities such as fishing or laundry (see Figure 2), if not simply filled with rubbish. The drying up of water bodies and the changes in usage patterns deeply modified the urban landscape, relegating water bodies, if still existent, to dumping grounds. Today's survey of historical water bodies is thus a pale reflection of past grand urban waterscapes.

Topography, toponymy and a survey of urban areas that fill with water during the monsoon make it possible to reconstruct the hydro-system of the pre-modern city. Figure 7 proposes a model of a typical city under Solanki rule and its set of water access points. The city appears surrounded by a belt of water bodies, with the ritual lake being either the upstream lake or independently connected to the river. The *mala*, or chain, of lakes is composed of a series of water bodies of successively lesser quality, thus creating a purity orientation to the city. City wells and stepwells located outside the city gates on trading routes complete this model. Just as temples and significant constructions are

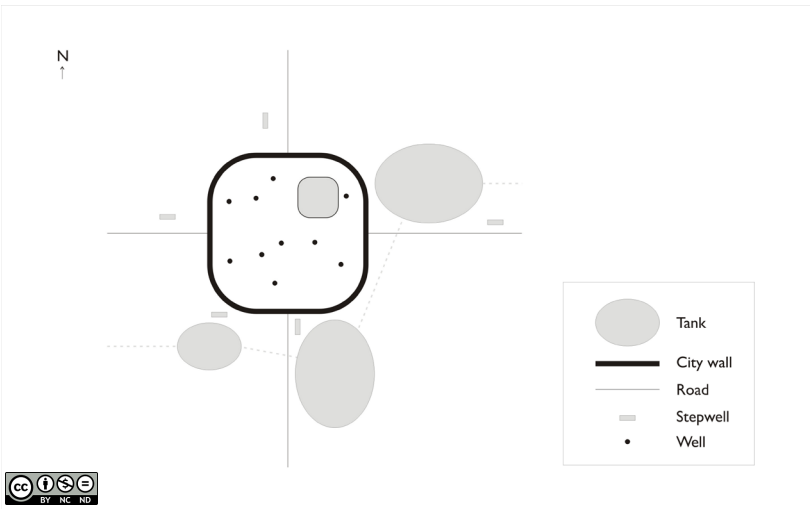

Figure 7:
Model of a Solanki city with its water facilities
compiled by Sara Keller

clustered near the ritual lake, the urban areas near the polluted endpoint of the hydro-system would house underprivileged social groups. Reconstructing the historical hydrological system of a city is thus necessary to understand its imaginary purity orientation and socially stratified residency. Sultanate cities, with their numerous garden foundations outside the ramparts, increased the blue/green belt around the walled city. Looking at this schematic reconstruction, water can arguably be used as a defining element of urbanity.

Sociability, religiosity and urbanity

Land/water boundaries in South Asia, based on the model of the *ghāt*s and a gradient access to water, imply the construction of steps for wells, reservoirs, river banks and lakes. Medieval (Solanki and Vaghela) *ghāt*s were enhanced with religious structures such as shrines, canopies and sculptures following the Brahmanical and Jain Maru-Gurjara style (Figures 2 and 4). This ornamentation contributed, with the monumentality of the construction, to an elaborate staging, aimed at awakening an emotional and devotional response.[23]

Stepwells, tanks and lakes share common religious material with an emphasis on Varuna, Vaishnavit deities, Mother-goddesses and representations of local *yakṣas* and *deva*s. Apart from daily rituals and regular shrine worship, the *ghāt*s were also sites of exceptional ceremonies, making them one of the vibrant spaces for religiosity in the urban space (Jain-Neubauer 1981, 2016; Masani 1918).[24] Seasonal and non-regular ceremonies included religious events related to fertility, life and death, such as funeral ceremonies, idol immersions and other festivals, dance and tantric practices (Samuel 2008, Gordon White 2006).

Water as a symbol of life and fertility was associated with womanhood, and the *ghāt* remained a privileged space for women (Sharma 2009: 89). Stepwells and *ghāt*s were essential spaces of sociability for women, especially in early morning hours when they gathered for bathing, ablutions, laundry and/or water collection. In a larger framework, "[water repositories] were the focal point of community congregation. In a nutshell, water was a vitally integral factor in the entire circuit of life and of human activity" (Sharma 2009: 105; Figures 2 and 3). Indian water structures from the third urbanisation phase onwards must therefore not be mistaken for merely technological and infrastructural elements: they are central places of religiosity and sociability.

23 The staging of the religious dimension of the monument contributes to the exaltation of emotions, thus stimulation devotion and social cohesion: "Cette atmosphère sacrée et l'expérience partagée deviennent une garantie de cohésion sociale" (Beaurin et al. 2018: § 17). See also Sharma (2009: 107): "The water tanks inspired religiosity, and themselves became the hub of religiocultural activity, on a grand scale."

24 "[…] d'apprester à manger, ce qu'ils ne peuvent faire sans s'estre lavez; joint qu'ils croient qu'en se lavant dans de l'eau courante leur pechez en sont mieux effacez" (Tavernier 1679 II: 65–66).

From the fifteenth century onwards, during the Sultanate period, a series of new water structures were constructed. The Sultans of Gujarat were indeed prolific builders and they accompanied their urbanisation endeavours with numerous wells, stepwells and tank foundations, some of them greatly surpassing in size earlier constructions – such as the Kankaria lake near Ahmedabad (Keller 2022). Water was encountered in pleasure gardens (such as the Kankaria or the Malik Shaban lakes in Ahmedabad), in mosque gardens symbolising paradise and in places dedicated to introspection and meditation (as in the Sarkhej complex southwest of Ahmedabad). In the context of Islam, water remained an essential element of places of worship but lost its sacred dimension. While religious activities crystallised in defined spaces, essentially in mosques, other spaces perceived as sacred in the Jain and Brahmanical context became places of recreation, containing water bodies, large trees, garden areas, etc. Liberated from the heavy sculptural style of the Jain and Brahmanical architecture, the Sultanate water bodies focused on the sensory experience. Despite this radical change of meaning and religious narrative, differentiated hydrospaces and *extra muros* water bodies and stepwells remained essential markers of the Western Indian cityscape.

The emphasis on the visibility of water in the city is not unique to Western India. South Asian cities in general developed their visual identity around waterscapes, whether *ghāt*s like in Varanasi, water channels like in Angkor Wat or *baoli*s (stepped tanks), stepwells and tanks like in many towns of North and South India. Water spaces were, besides the marketplace, one of the major places of sociability. Water is not just a marker of the city, but a defining element of Indian urbanity. Urbanity is a notion that still remains to be explored in greater detail in India. The city wall certainly defines the territory of the city, both as a physical and a metaphysical entity. But urbanity refers to a larger concept, defined by Susanne Rau and Jörg Rüpke as "urban patterns of behaviour" (Rau / Rüpke 2018: 11; Rau 2011). Urbanity is a way of life conditioned by the dense and specialised environment of the city; sophisticated skills and behaviours expresses it best. South Asian monumental hydro-structures significantly contributed to Indian urbanity due to the advanced set of hydraulic, architectural and religious knowledge required to construct them. The accumulation of both the capital and knowledge necessary for this was available only in an urban context. In contrary to less equipped rural spaces,[25] the sophisticated lakes, tanks and stepwells demonstrate with great visibility the capacity of urban actors to master and domesticate their environment.

25 For a definition of urbanity that can be found outside the city, see Rüpke 2021, Rau / Rüpke 2018, and Keller 2022; in rural areas, sophisticated water places shaped pockets of urbanity.

Conclusion

Despite the early fifteenth century being marked by obvious political and religious changes at the state level, the hydro system of the Western Indian city shows several elements of continuity from the Solanki to the Sultanate period (tenth to sixteenth centuries). The historical and archaeological reconstruction of the urban water elements over this long period makes it possible to propose a workable model, although I expect further work to suggest nuances and evolutionary tendencies. Nevertheless, this preliminary work makes the following conclusions possible:

1) Western Indian cities were equipped with monumental and sophisticated structures of great visibility. These were essential places of sociability that facilitated social bonding and cross-community interactions. This visibility and advanced features rendered the waterscape an essential marker of Indian urbanity.
2) Despite impressive hydraulic structures, urban spaces were poorly equipped with infrastructural elements. When infrastructure was lacking, human workers provided the essential link between urban structures. This resulted in water being a primary agent of social dependency and social differentiation, while a minority was freed from water-accessing activities.
3) Water was accessible in a large variety of places and qualities (reflected in linguistic diversity[26]). Each individual or household obtained different water for different purposes. The variety of water structures reflected water grading and social differentiation. Water grading also defined occupations and city orientation. The chain of suburban lakes defined the orientation of the city.
4) The artificial lake developed as an essential water response to the topographical and climatic conditions of Western India. Lakes and other large water bodies such as rivers, city moats and ponds were associated with wells and stepwells. This association allowed the recharging of aquifers and provided water for wells below the water table. Here also, water quality became differentiated, with aquifers acting as filters and providing cool drinking water in wells.

These observations show that, reflecting the ambiguous character of water itself, water spaces were catalysts of both inclusion and exclusion. The diversity of water donations (by different actors at different point of time) might seem to give an impression of inconsistency, further emphasised by the scientific documentation of individual historical water structures. Stepwells, tanks and reservoirs might appear to be isolated and non-connected. On the contrary,

26 *Jal* often refers to *pavitr jal* or "sacred water", while *pānī* is commonly used in Hindi for "water". Sanskrit texts use different terms such as *ap*, *udaka*, *udra* and *udan* (Angermeier 2020: 292).

however, this study shows a more holistic perspective: hydro-structures were linked elements whose efficiency was guaranteed by the vibrancy of a large network of water constructions and natural water bodies. Each new addition to the existing facilities reflected a global understanding of the urban water scheme. Despite the absence of centralised and historically coherent water projects (which speaks for the findings by Farhat Naz and Saravanan V. Subramaniam, and against the Wittfolgel model of oriental despotism by water, see Naz / Subramanian 2010), the picture of hydro-structures at the scale of the city demonstrates a hydro-intelligence based on hydraulic knowledge and hydro-diversity.

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