WATER AND URBANITY

MAPPING WATER IN THE INDIAN MEDIEVAL CITY

Habilitation Project
at the Max Weber Centre for Advanced Cultural and Social Studies
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Abstract

Recent surveys on Indian water architecture prove the importance of waterscape in the Indian cities. Yet these exhaustive records lack in analysing the significance of water infrastructures for the city, its social life and its plural power. My habilitation project aims to survey hydraulic structures, to map the water geography of the Indian city and to follow its evolutions. This study will reveal the close connection of water, urbanity and power.

> "In the beginning, he created only the waters, and then, in the waters, he laid his seed. And this became a golden egg... In this egg Brahmā was born of himself, the ancestor of all living things".
>
> *Mānava Dharmäśāstra*, 1.8-9[1]

Indian architectural tradition understands the space as a living organism, a body: the body of the mythical *Purusha* tamed by the Gods on earth.[2] Respecting this cosmology, a city is perceived as a large body with its identity (landscape and population), its organs (outstanding buildings and spaces), its circulation and subtle flows (streets, traffic, spheres of influence). However, today, the global image of a city is lost, provided the absence of records regarding the initial plan, but also because of the lack of comprehensive analyses of its existing landscape. Looking at a particular Indian city, what are its topographical and architectural characteristics, what is the social, political and religious significance of its built body and how did this landscape evolve in time? With these issues, a methodological question raises: how to draw the Indian city, its urbanity and evolution adequately; what could be the graphical conventions that are relevant to the Indian context?

These are the questions that my habilitation project aims to answer with the support of historical analyses, building archaeological documentation and topographical surveys. Water being a determining element for the domestic, economic and religious urban life, as well as a crucial social and political indicator, a special focus will be given to monuments and constructions related to water management.
Both the selected urban monographies (Dabhoi, Gujarat and Calicut, Kerala) will give insight into the identity of cities connected with the Indian Western littoral, and affected, each in their own way, by deep social, political and architectural shifts during the 15th and 16th century. The project will therefore also engage itself with comparative discussions in regards to other cities of the Indian Ocean and their hydrologic strategies.[3]

My past researches

My dissertation about the monuments of the walled city of Ahmedabad[4] gave me the opportunity to engage myself in details with the topography and architectural landscape of a significant Western Indian city: Ahmedabad. The historical capital of Gujarat (founded 1411) has indeed an extraordinary rich heritage and architectural potential for which the city was recently recognised as the first World Heritage City of India by the UNESCO (July 2017). My analysis of the historical monuments of Ahmedabad (mosques and Islamic sites, city wall, palace compound) and the street network gave new insights about the historical development of the city. It showed

[1] John, V.J. (ed). 2007. *Water Struggle*. Bishop's College, Kolkata. pp.37-38.
[2] The drawing of the *Vastu Purusha* represents the task of the master architect who plans a building. The Indian science of architecture has been transmitted orally. References are given in the *Vastu Shastra*, the *Sthapatya Veda* and the *Smriti Shastra*.
[3] Keller, Sara (ed.) 2019. *Knowledge and the Indian Ocean - Intangible Networks of Western India and Beyond*, (ed.) Palgrave Series in Indian Ocean World Studies, Palgrave Macmillan, XLI.
[4] Keller, Sara. 2009. *The Mirror of Gujarat. Islamic Monuments of Ahmedabad walled city (India, 15th-18th C.). A building archaeological study*. 3 volumes. Unpublished dissertation thesis available in all the French University libraries.

in particular that the 'pol' organisation (arrangements of countless residential community streets) was not the sole historical structure of the city. In contrary, it grew on the basis on large 'pura-s' or master quarters, that were developed by the military officers and members of the Sultan's court. It is only in the late 16th century and towards the collapse of the Sultanate and the Mughal invasion that the *pura*-s dissolved into numerous autonomous 'pol-s' managed by its community inhabitants.
In the framework of this research work, I also studied the 'tānkā', the domestic underground cistern. I could trace the first *tānkā*'s construction in the late 16th century, while the city was initially supplied with water from wells and large ponds built by the Sultan and his contemporary aristocracy. In Ahmedabad, both city structure and water infrastructures show that the Mughal invasion sealed the time of a glorious architectural governance for new patterns based on micro-infrastructures and inhabitant's autonomy.
It proved that water accessibility and water distribution conditions the urbanity since it decides upon the location and the shape of the city.

I then surveyed, in the framework of my historical and archaeological appointment for the APIM project,[5] the Islamic monuments of all the major port towns of Gujarat from Kutchchh to Saurashtra and the Gulf of Khambhat. The lack of topographical information was a serious issue to initiate the documentation, and I therefore engage myself in preliminary topographical surveys in many cases. I especially created base maps of the cities of Bharuch and Cambay, both the dominating pre-Mughal port towns of Gujarat.[6]
This topographical work and architectural surveys, completed by a historical research, brought to light crucial clues concerning the organisation of the urban space, the impact of religious landmark on urbanity and the interrelationship between political hazards and city geography. Water structures clearly appears as a relevant entry point for the understanding of the city, especially for early period deprived of written sources. Moreover, the port towns, as gateways to the Indian Ocean, proved to be catalysts of overseas intangible knowledge, thus deeply affecting the Indian subcontinent (see my recent edited volume *Knowledge and the Indian Ocean - Intangible Networks of Western India and Beyond*).[7]

[5] The 'Atlas des ports et des itinéraires maritimes de l'Islam médiéval' is a data bank project initiated by the French research centres 'CNRS, UMR Orient & Méditerranée', Panthéon-Sorbonne University, 'ANR Median' and 'ANR Detroit'. The data bank is partially accessible online via: https://apim.fmcloud.fm/APIM/db/main.php. I was appointed for the surveys of Western Indian port cities. My archaeological campaigns for the APIM projects spread from 2010 to 2015.
[6]See the upcoming cartography of Cambay and Ahmedabad: "Commercial and artisanal activities in the city of Cambay" (map and description), "Commercial and artisanal activities in the city of Ahmedabad" (map and description). Accepted for *Atlas des villes et territoires de l'Islam médiéval (Xe-XVe s.),* a publication by the Medieval Islam Research Lab, Paris (Sylvie Denoix, Elodie Vigouroux). See also the data available on APIM webpage, and my publications on Bharuch: Keller, Sara. "The False Canons of Bharuch Barbican. A fortified Custom House". Accepted by the IFAO for the post conference volume of the EAA meeting (Istanbul, 2014), publication scheduled 2019. Keller, Sara. 2015. "Bharuch Fort during the pre-Sultanate Period", in M.F. Boussac, J.F. Salles et J.B. Yon (eds), *Ports of the Ancient Indian Ocean*, Primus, pp. 217-234. Keller, Sara. 2015. "Bharuch, the City Fortress", in Keller, S. et Pearson, M. (eds), *Port Towns of Gujarat*, Primus, pp. 213-229. Keller, Sara. 2014. "Bharuch Heritage". Bilingual brochures (English-Gujarati) on Bharuch heritage, printed with the support of the French Embassy in India.
[7] Keller, Sara (ed.). 2019. Knowledge and the Indian Ocean - Intangible Networks of Western India and Beyond, Palgrave Series in Indian Ocean World Studies, Palgrave Macmillan.

Water structures

Since the 1990s, detailed monographies on historical water structures such as step wells, *tānkā*-s and garden embellishments brought insightful information about the architectural, religious and political meaning of the monuments.[8] They were completed by several surveys initiated in the framework of the raising interest for heritage in India during the 1990s and 2000s. Other studies were motivated by recent concerns regarding the supply of basic amenities and the challenge of water management and water quality in modern India.[9] However, historical water technology and urban waterscape remain marginal subjects. Systematic surveys are missing to give a fair picture of the urban geography of water structures and its evolution through time.

Technology has been a primary concern of the Western social scientist who might be disappointed by the lack of interest, in India, for the history of technology and mechanist science. Yet Indian historians and scholars have offered a major input on early sciences and (especially for us here) ancient treatises on hydrology. An abundant Sanskrit literature shows that ancient India had a basic knowledge on hydrological cycles, it knew how to measure rainfall and could estimate the height of the water table.[10] Rainwater, surface water and subterranean water was clearly differentiated and appreciated for its intrinsic values. Thus, early medieval India could construct structures that requires high engineering skills.

This assumption is confirmed by archaeological findings such as water sluices and other monumental constructions for the supply of large cities: this is the case of the water sluices and tank of Sahasralinga near Patan, early 12th century, the gigantic Sharmishtha lake near Vadnagar, 11-12th century, the Kankaria lake, built near Ahmedabad in 1451 and many others.
The sustainability of early medieval cities of Western Indian (i.e. today's Gujarat, South Rajasthan and North Maharashtra) rely on infrastructures capable of providing water throughout the year in a climate subject to a seasonal rain. Two major sources of fresh water fulfilled the need of drinking and domestic water: bored wells reaching underground water level and open tank/pond/lake harvesting rain water during the rainy season. The above-mentioned bibliography and surveys in Gujarat and Rajasthan demonstrated the richness of water structures, especially artificial lakes and stepwells built during the Sultanate and pre -Sultanate period (11th till 16th

[8]Agarwal, Anil and Narain, Sunita. 1997. *Dying Wisdom: Rise, Fall and Potential of India's Traditional Water Harvesting Systems*. Centre for Science and Environment. Jain-Neubauer, Jutta. 1981. *The Stepwells of Gujarat*; Livingston, Morna. 2002. *Steps to Water*. Princeton Architectural Press. Shankari, Uma and Shah, Esha. 1993. *Water Management Traditions in India*. PPST Foundation, Madras. Porter, Yves. 1992. "Adduction et stockage de l'eau à Delhi aux 13e et 14e siècles." *Archéologie islamique*, 3, Paris, pp.169-183; Shokoohy, Mehrdad and Shokoohy, Natalie H. 2003. "Tughluqabad" *BSOAS*, University of London, 66(1), pp. 14-55. Welch, Antony. 1996. "A Medieval Center of Learning in India: The Hauz Khas Madrasa in Delhi." *Muqarnas* Volume XIII. Leiden: E.J. Brill. pp. 165-190. Wescoat, James. 1985. "Early Water Systems in Mughal India". *Environmental Design: Journal of the Islamic Environmental Design Research Centre*, pp.51-57; Shukla, S. P. 2001. *Water Management and Hydraulic Engineering in India (c. 600 BCE – CE 1200).* Pentagon Press. Hegewald, Julia.2002. *Water Architecture in South Asia: A Study of Types Developments and Meanings*. Studies in Asian Art and Archaeology No. 24, Brill, Leiden, 2002. Jain-Neubauer, Jutta. 2016. *Water Design: Environment and Histories*. Volume 68 Number 1. Marq.

[9]See the publications of environmentalist and water conservationist Anupam Mishra, especially: Mishra, Anupam. 2001. *Traditions de l'eau dans le désert indien. Les gouttes de lumière du Rajasthan*, trad. Annie Montaud. Paris, L'Harmattan.

[10] "The ancient Indian literature contains numerous references to hydrology and a reading of it suggests that those people knew the basic concepts of hydrological processes and measurements." (58). Jain, Sharad K.; Agarwal, Pushpendra K.; Singh. Vijay P. 2007. *Hydrology and Water Resources of India*. Springer Netherlands.

century). The grandness of these constructions proves the commitment of the rulers towards the supply of basic amenities. They also demonstrate the tightness of a social network capable of taking responsibility of maintaining these (sometimes gigantic) structures. Ghāts of the tanks and walls of the stepwells were exhaustively enhanced by shrines and deities depictions,[11] thus underlining the sacrality of the place and the close connection of the divine and the secular.[12] They abundant ornamentation and religious references underline the representation purpose of these structures: water was a royal prerogative and water infrastructures participated to the theatrical production of power and religion.

Introduction of the water cistern

Today's most obvious traditional source of water in urban Gujarat is the 'tānkā', the water cistern. The *tānkā* drew the attention of architects and heritage specialists in the last decades, which resulted in the documentation and restoration of numerous cisterns in Ahmedabad and Bharuch.[13] It is a system of rooftop harvesting system whereas an underground cistern built below the courtyard of the house serves as stocking space for the rain water collected during *mansoon*, the rainy season. A sophisticated knowledge concerning the construction of the cistern (including lime washing and excluded exposure to sunlight) and its use and maintenance has proved the efficiency of the cistern and the quality of its water.[14] Up to date, *tānkā* water is preferred for the cooking of hard beans, since it is known for its sweetness and quality. Today, it seems to be the main traditional water harvesting system of urban Gujarat.

Nevertheless, my historical study of the *tānkā* of Ahmedabad walled city showed that the underground water cistern does not reach back more than 500 years. During the late Sultanate period and the Mughal era, the disengagement of the local authority towards urban affairs, especially security and infrastructures maintenance, drove the inhabitants to abandon the traditional global water system. They instead shifted to solutions providing them a necessary autonomy. The private water cistern thus represents the reappropriation, by the city inhabitants, of royal prerogatives. In this perspective, the dissolution of the aristocratic governance deeply shook the city identity: during the Mughal periods, social unrests and changes in the architectural landscape speak for a city that needed to redefine itself.

City and religion

This sudden and drastic shift raises the question of the religious dimension of the water structures. Not only the new architectural element is exempt of devotional expression, but it

[11] Jain-Neubauer 1981 and 2016.

[12] Water is "liquified knowledge" and therefore needs to be controlled by the local power(s). Jain-Neubauer 2016, p.24 and 27.

[13] But also Cambay, Diu etc. See Kapadia, Kapas. 2003. "The Tānka of Bharuch." *Craft Revival Quarterly*. Shankari and Shah 1993. Agarwal and Narain 1997. Singh 2000. Amiraly, Akil. 2005. "La réhabilitation des systems alternatifs d'approvisionnement en eau. " Post-Print hal-00262996. Amiraly, Akil. Prime; Nathalie and Singh, J.P. 2004. "Rainwater Harvesting, alternative to the water supply in Indian urban areas: The case of Ahmedabad" Gujarat Working Paper, IIMA Working Paper Series, Indian Institute of Management of Ahmedabad, India. halshs-00138830.

[14] "Il convient de mentionner ici que la partie intérieure de la citerne est plongée dans l'obscurité, ce qui empêche la prolifération de chlorophylle véhiculant algues et microbes. En eau stagnante, l'algue constitue une source d'alimentation pour les microbes ; ainsi, l'absence d'algue rend difficile la croissance de bactéries" (Amiraly 2005, p.15).

contradicts in its design itself the tradition of keeping water in open air. Water was worshiped as *Udaka*, a living element. The daily rituals related to water were not just important to guarantee abundance of drinking water, but also harmony in the place and money flow. Water being linked with finance had an existential meaning in rich commercial Gujarat. While access to water was modified, dealing with *Udaka*, had to be redesigned.[15] To shut up water is a violent disruption with the believes of the religions from Vedic affiliation (especially Hinduism and Jaïnism)[16] thus embodying in the city landscape a drastic religious shift. This shows that, thought the province of Gujarat was under Muslim rule since about two centuries, the cultural colonisation was enshrined only in the early years of the Mughal domination (Gujarat was invaded in 1572-3).
The change in interaction with water is a transversal issue affecting architecture, urbanity, power and religion.
Converging factors seem to be the cause of this dramatic changes: on one hand, the weakening of the local political power (the sultanate is here to be understood as a period of continuity), on the other hand the pression of strong western models via overseas contacts with the West (and, beyond it, the Middle East and the Mediterranean antique heritage).

Climatologic parameter

Long term hydrological data could give another view on the changes affecting the water supply of Indian cities from the 14th-15th century onwards. According to paleoflood hydrological studies, large magnitude floods such as early medieval India have experienced seem to have crossed a sudden recession between the 14th to the 19th century:[17]
"The regional palaeoflood chronology reveals that the period between ca. 14th and 19th century AD was marked by a sharp decline in the frequency of large floods on most rivers under investigation (...) This period of low-magnitude floods coincides roughly with the widespread and the well-known Little Ice Age (LIA) that was marked by cooler and drier conditions and a weakening of the southwest monsoon" (Kale 2008, p.63-4)
Could the climatic parameters have triggered a human response in terms of water supply organisation? I would therefore encourage a discussion with geologists and paleoclimatologists in order to open a new path of research.

Water and sociological dimension of the city

In a highly hierarchised society, water was a matter of inclusion and exclusion: "Designing and spatially positioning waterbodies or embarkments at natural lakes or rivers has been partially determined by the notion of communal contamination and isolation" (Jain-Neubauer 2016, p.9). In this context, the architectural patron was responsible of regulating the management of

[15] Cama shows in her articles the influence, in Gujarat, of Parsi water rituals in the context of using an underground cistern (Cama, Shernaz. 2019. "Ava. A Living Tradition of Reverence for Water Among the Zoroastrians". In Keller (ed.). *Knowledge and the Indian Ocean - Intangible Networks of Western India and Beyond*, Palgrave Series in Indian Ocean World Studies, Palgrave Macmillan.
[16] In Hinduism, water is the seed of life and a living element. In the beginning is water -an evidence crystallized in the Indian cosmogony with the myth of the cosmic waters containing the seeds of creation (see introductory above). It is also a determining agent of the architectural designing process since the Vastu Shastra is based on the balance of all the elements in the to-be-built space.
[17] Kale, Vishwas. 2008. "Palaeoflood hydrology in the Indian context" in *Journal of the Geological Society of India* 71(1):56-66.

customary rights, and, in needful cases, to enact judicially.[18] To map the water structures in the city will therefore bring crucial clues concerning the sociological and demographical identity of the concerned urban centre. What was the sphere of use and influence of each water structure? Do we have complementary historical or epigraphical elements on the management of customary rights? How relevant is the evolution of water landmarks for the understanding of mobile powers?

The habilitation project: methods and program

It is clear that the Indian city can't be understood in static views: the urban body and its living expression was challenged in the course of time. Its changes are closely linked with the political and religious events, thus affecting its core identity. The project targets to bring innovative elements in order to confirm, complete, rectify, explain this hypothesis. My approach for this project is both historical and building archaeological. The research work will fill archaeological gaps (stepwells and *tānkā* are now well documented structures, shadowing the importance of the Solanki contribution), and bring to light the impact of cross continental connections on the relationship India had with water.

First the project will historically and archaeologically document the water structures of Western India built prior introduction of the cistern, with a special focus on the Solanki architectural remains (11th and 12th century). How was the urban water supply functioning before the *tānkā*? What are the technical and aesthetic perspectives of the pre-Sultanate hydraulic systems, when exactly did the shift occur, what are the comparative elements with the new water model introduced during the 16th century? The project will focus on three major Solanki architectural sets: the Sahasralinga lake (early 12th century, supplying the city of Anhilwad Patan, capital of the Solanki), the Munsar lake (built about 1090 near Viramgam) and the integrated hydraulic system of the city of Dabhoi. The city of Dabhoi, aside the industrialisation belt of Gujarat, was preserved from rash modern development. Its major interest lies in its foundation and planed urban structure. Dabhoi is an early medieval city and pilgrimage centre that was fortified by the Solanki (Chaulukya) king Jayasimha Siddharaja (1093-1143 AD). The square shape of its fort wall and its regular street network make it an ideal study case of a city planned on *Vastu Shastra*. The monography of Dabhoi will be the occasion to map an almost undisturbed Vastu city and to discover its hydraulic pattern.

Secondly, a study of water structures of medieval Malabar cities will provide information regarding the traditional urban water systems of South-West India and the potential changes brought by technics, believe and knowledge imported via overseas routes. Were the cities of the Malabar coast supplied by centralised hydraulic infrastructures? Are they water cistern or other exogenous water systems?[19] I will particularly look into Calicut (Kozhikode), an active Malabar

[18] Gunawardana, R.A.L.H. 1978. "Hydraulic Engineering in Ancient Sri Lanka: The Cistern Sluices", in Paranavitana, Senarat; Prematilleka, Leelananda and van Lohuizen-De Leeuw, Johanna Engelberta (eds.). *Studies in South Asian Culture, Senarat Paranavitana Commemoration Volume*. Edited for the Institute of South Asian Archaeology University of Amsterdam, Vol.VII, Brill, Leiden, pp.61-74.

[19]The surangas found on the Malabar coast are networks of water tunnels inspired from the Qanat, thus hinting at a technological transfer via sea route: "One may assume its relation to Qanat, a traditional water harvest system rooted in the Middle Eastern countries since 700 BC, through the trade contacts with the Arabic Muslims settled in the Malabar coast as early as 7th century." Suseelan, A. 2008. "Investigating the relation of a sustainable vernacular technique to settlement pattern", in Feyen, Jan; Shannon, Kelly and Neville, Matthew (eds.). *Water and Urban*

port town during the antiquity and medieval period. Its early connection with the Arabian Peninsula, and the West part of the Indian Ocean in general, creates a noteworthy parallel with port towns of North West India.

Finally, a comparative study will provide elements regarding water and urbanity in the Persian world, the Arab cities and the large South-East Asia / Far East: What are the water systems in use in the respective contemporary urban contexts, and what are their associated believes, rituals and imaginaries regarding water? How did water knowledge travel and what was the decisive element that supported the implementation of foreign knowledge regarding water?

The habilitation project will include yearly field trips in India for surveying purpose. This will be the occasion to maintain collaboration relationship with my colleagues from the Maharaja University, Baroda (MSU), also from CEPT (Ahmedabad School of architecture) and NID (National Institute of Design, Ahmedabad) and other experts working on urbanisation in Gujarat and Kerala.

Working schedule

Period 1. 1st April 2019 to 31st January 2020.
1st April 2019 to 8th October 2019: Collection of bibliographical information regarding water structures in the cities of the Western Indian littoral, from Kutch to the Malabar coast. Bibliographical research on water management systems in the Arabic peninsula, the Persian world and other littoral of the Indian Ocean. Collection of bibliographical data about Dabhoi history, preparation of a map base in the perspective of surveys. Initial contact with local colleagues in order to consider collaboration during my field trip (seminar, survey workshop for students etc.).

8th to 22th October 2019: First field field trip to survey Dabhoi city, especially its waterscape. Visits of the Sahasralinga tank near Patan and the Munsar lake of Viramgam. Visits at the MSU (and /or other institutions). Access to local bibliography (especially Archaeological Survey of India reports, conserved in ASI Baroda circle in Puratatva Bhawan, Baroda, also the Hansa Mehta Library of MSU), and collection of relevant archival and historical data.

31st January 2020: Completion of the creation of maps and drawings resulting from the first field trip.

Period 2. 1st February 2020 to 1st February 2021:
1st February 2020 to 20th October 2020: Collection of bibliographical information regarding water structures in the cities of the Malabar coast other littoral of the Indian Ocean.
Collection of historical data about Calicut history, preparation of a map base in the perspective of surveys. Initial contact with local colleagues and potential contacts.

20th October- 10th November 2020: Second field trip for the survey of Calicut waterscape and collection of local bibliographical data.

Development Paradigms: Towards an Integration of Engineering, Design and management Approaches. CRC Press. p.474.

1st February 2021: Completion of the creation of maps and drawings resulting from the Kerala field trip.

Period 3. 1st February 2021 to 1st April 2022:
1st February 2021- 10th January 2022: Work on the bibliographical information collected during both the field trip. Compiling the data of the bibliographical work and all the surveys. Preparation of last field trip.

10th January 2022- 1st February 2022: Third field trip to check missing archaeological information, meet the local partners and conduct a concluding seminar.

1st April 2022: Completion of documents to be published and finalisation of the habilitation report.