The Sarasvati River: Old and New Perspectives

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I
Sarasvati: a “mythical river”? Traced by satellite imagery?
The Problem

- The *Rig-Veda* often mentions the *Saptasindhava* or "land of the seven rivers", identified by scholarly consensus with the land where the Indus (in the west), its five tributaries, and the Sarasvatī (in the east) flow.

- The Sarasvatī is described as full of "great waters" (1.3.12) whose "impetuous" flow is "unbroken, swift-moving" (7.95.1) "from the mountain to the sea" (*giribhya ā samudrāt*) (7.95.2).

- The Sarasvatī receives the highest praise and is the only deified river in the Rig-Veda: she is "the best of mothers, the best of rivers, best of goddesses" (*ambitame nadītame devitame sarasvatī*, 2.41.16).
The Nadīstuti Sūkta

Nadīstuti sūkta (Rig-Veda, 10.75) lists 19 rivers from east to west:

O Gangā, Yamunā, Sarasvatī, Shutudri (= Sutlej), Parushni (= Ravi), hear my praise!
Listen to my call, Asikni (= Chenab), Marudvridha (= Maruvardhvan), Vitasta (= Jhelum) with Arjikiya, Sushoma (= Sohan).
The geography of the Rig-Veda: but where is the Sarasvatī?
Detail of the first map pointing to the “Soorsuty” as a tributary of the “Guggur”
(The Library Atlas by Bryce, Collier & Schmitz, 1760)
Map by James Rennel, Surveyor General of Bengal, in his *Memoir of a Map of Hindoostan*, 1778
(Courtesy: Saraswati Mahal Library)
In the early nineteenth century, topographic surveys of the Thar Desert by Lt. Colonel James Tod (1820s), Major Colvin (1833) and Major Mackeson (1844) resulted in the following observations:

1. A wide dry bed called “Ghaggar” dotted with ancient ruins.
2. A local tradition according to which the drying up of the river caused the region’s desolation.
3. The presence of freshwater wells along the Ghaggar’s bed, which would allow “large bodies of troops moving by it” (if the colonial powers wanted to invade Sindh by that route).
4. A seasonal river called “Sarsuti” among the Ghaggar’s tributaries.
French geographer Louis Vivien de Saint-Martin, author in 1855 (1860) of *A Study on the Geography and the Primitive People of India’s North-West, According to Vedic Hymns*, was the first European scholar to propose that the Ghaggar system was a relic of the Vedic Sarasvatī: “The trace of the ancient riverbed was recently found, still quite recognizable, and was followed far to the west. [This discovery] confirmed the correctness of the tradition.”
A. Cunningham’s map of 1871 (detail)
C.F. Oldham, surgeon-major in the Indian Army: ‘Although the river below the confluence [with the Ghaggar] is marked in our maps as Gaggar, it was formerly the Saraswatī; that name is still known amongst the people.’ (map of 1883)
Vinashana is an important pilgrimage site in the *Pañcavimsha Brāhmaṇa* (25.10.6) and *Jaiminya Upanishad Brāhmaṇa* (4.26).

Detail of French Indologist Louis Renou’s map of the Mahābhārata age.
The present-day seasonal Ghaggar with its chief tributaries. (Map by Michel Danino)
“The identity of the first four rivers here enumerated [Gangā, Yamunā, Sarasvatī, Shutudri in RV 10.75] ... is subject to no doubt. They correspond to the present Ganges, Jumna, Sarsuti, Sutlej ... The order in which the first four are mentioned exactly agrees with their geographical sequence from east to west.”

— Marc Aurel Stein, 1917
Marc Aurel Stein (1862-1943) explored the states of Bikaner and Bahawalpur in the winter of 1940–41. His 1942 paper was titled “A Survey of Ancient Sites along the ‘Lost’ Sarasvatí River”.

Mature Harappan sites in the Sarasvatī basin
(Michel Danino, based on Mughal, Joshi, Misra)
Overall distribution of Harappan sites: besides the Indus Valley, the Sarasvatī Valley and Gujarat are major heartlands of the Indus civilization. (Table by Michel Danino, based on S.P. Gupta & G.L. Possehl)

<table>
<thead>
<tr>
<th>Regions of the subcontinent</th>
<th>Early Harappan</th>
<th>Mature Harappan</th>
<th>Late Harappan</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sarasvati valley</td>
<td>640</td>
<td>360</td>
<td>1378</td>
<td>2378</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>2</td>
<td>32</td>
<td>10</td>
<td>44</td>
</tr>
<tr>
<td>Himachal, Jammu &amp; Delhi</td>
<td>1</td>
<td>–</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Gujarat</td>
<td>11</td>
<td>310</td>
<td>198</td>
<td>519</td>
</tr>
<tr>
<td>Pakistan’s Indus basin &amp; western regions</td>
<td>367</td>
<td>416</td>
<td>12</td>
<td>795</td>
</tr>
<tr>
<td>Total</td>
<td>1021</td>
<td>1118</td>
<td>1602</td>
<td>3741</td>
</tr>
</tbody>
</table>
Evolution of the settlement pattern in the Sarasvatī basin. While the river first breaks up about 2700 BCE (in Cholistan), its central part is abandoned by Harappans around 1900 BCE, pointing to the river’s final break-up, with Late Harappan sites clustering close to the foothills of the Shivalik Hills.

(Maps by Michel Danino)
Abandonment of the central Sarasvati basin c. 1900 BCE.
(L. Giosan, P. Clift et al., 2012)
Sarasvatī: a scholarly consensus

The identity between the Sarasvatī and the Ghaggar-Hakra was accepted by the following scholars, among many others:

- **Geographers:**
  - L. Vivien de Saint-Martin (1855)
  - H. Wilhelmy (1969)

- **Geologists:**
  - R.D. Oldham (1886)
  - V.M.K. Puri, K.S. Valdiya (1990s)

- **Indologists:**
  - H.H. Wilson (1840)
  - F. Max Müller (1859)
  - C.F. Oldham (1874)
  - M. Monier-William (1875)
  - A. Weber (1878)
  - L. Renou & J. Filliozat (1947)

- **Archaeologists:**
  - Marc Aurel Stein (1917, 1941)
  - Mortimer Wheeler (1950s)
  - S.P. Gupta (1989)
  - V.N. Misra (1994)
  - B.B. Lal (1997)
  - Gregory Possehl (1999)
  - R.S. Bisht (1990s)
  - D.K. Chakrabarti (1990s)
  - Jane McIntosh (2002)
A few examples of recent maps published by archaeologists.
(Clockwise from top left: J.-M. Casal, G. Erdosy, R. & B. Allchin, G.L. Possehl, J. McIntosh, J.M. Kenoyer)
Satellite photo of the Sarasvatī basin (LANDSAT, in the 1970s)
Courses of the Sarasvatī determined by satellite imagery, with contributions from the Yamuna and the Sutlej (Yash Pal and others, 1980)
Harappan sites plotted along the course of the Sarasvati (RRSC, ISRO, Jodhpur)
Courses of the Sarasvatī (ISRO)
II

Recent studies
Palaeochannels

(S.M. Mehdi et al., 2016)
Three major palaeochannels identified through remote sensing (S.M. Mehdi et al., 2016)
Sample locations for sediment studies (S.M. Mehdi et al., 2016)
Lithologs
(S.M. Mehdi et al., 2016)
Palaeo-rivers compiled from several remote sensing studies.
(Orengo and Petrie, 2017)
“The factors influencing water availability along the Ghaggar–Hakra basin are much more complex than previously thought. The traces of palaeo-rivers that have been identified cover the entirety of the landscape in the northern sector forming an almost continuous parallel pattern, which points to the changing nature of these channels and the likelihood that floods and river avulsions have been a relative common occurrence. ... All these factors join to create an extremely complex picture in which water availability and location is dependent upon a multiplicity of factors and difficult to predict in the long term.”

(Orengo and Petrie, 2017)
Buried channel systems in Haryana. Younger fluvial activity in a limited area is dated through OSL between ~6.0 and ~2.9 Ka BP. (H.S. Saini, S.K. Tandon et al, 2009)
Water-bearing sand layers identified through resistivity study. (Sinha et al., 2013)
Water-bearing sand layers identified through resistivity study.
(Khan and Sinha, 2019)
The “mighty Sarasvatī”


- Others have disagreed: “Reliable monsoon rains were able to sustain perennial rivers earlier during the Holocene and explains why Harappan settlements flourished along the entire Ghaggar-Hakra system without access to a glacier-fed river. ... As the monsoon weakened, monsoonal rivers gradually dried or became seasonal, affecting habitability along their courses.” (Liviu Giosan, Peter D. Clift et al., 2012)
Khan and Sinha, 2019: These sand bodies are “deposits of a large river system which once connected the Yamuna with the Ghaggar system. ... A dense concentration of Harappan sites has been documented in the Jind and Hisar districts of Haryana and further west in the Ganganagar district of Rajasthan, and this can only be explained if the Yamuna once flowed through these southwesterly flowing palaeochannels. ... The palaeo-Yamuna does represent the courses of a major feeder to the Ghaggar–Hakra system (Sarasvati) as suggested by thick sand bodies. ... The avulsion/abandonment of the Yamuna to the east and the Sutlej to the west were nearly contemporaneous.”

This occurred at least 5,000 years before the Mature Harappan phase.
A. Chatterjee (2017): field data from the Ghaggar floodplain.
A. Chatterjee (2017): a typical section along the Ghaggar.
A. Chatterjee (2017): OSL dates of 36 ky between Hanumangarh and Kalibangan, 19 ky north of Kalibangan; but a sample at Hanumangarh returned much more recent dates of about 3400, 4000 and 6500 BCE.

“At Anupgarh a colony of fresh-water bivalve shells was encountered embedded in situ within this micaceous grey sand layer” — C14 dates of about 4000 BCE, which “can be considered as the depositional age of the fluvial sand horizon.”

A. Chatterjee & JS Ray (2017): Ghaggar alluvium at Kalibangan indicates that the river did have glacial sources during the early Holocene, but study of sediments as well as minerals of pottery suggests that the Ghaggar sediments used by potters did not have a higher Himalayan provenance: “during the time of the Mature Harappans the Ghaggar had already become a foothill-fed river.”
Abrupt shift in the monsoon worldwide in c. 2200 BCE. This probably meant a general decline in the total amount of monsoon precipitation and could have been a factor in the loss of the Sarasvati and the end of Harappan urbanism. (Berkelhammer et al., 2012)
Latest study (February 2014) of ratios of oxygen isotopes in gastropods (snail shells) from the sediments of palaeolake Kotla Dahar in Haryana points to a weakening of the Indian summer monsoon around 4100 years ago.

(Dolomite study: in Oman; Mawmluh Cave: in northeast India)

(Yama Dixit, David A. Hodell & Cameron A. Petrie)
Dave, Singhvi et al., 2019, conclude that “all the major rivers of Himalayan origin ceased to flow through this region before the Holocene, and certainly well before the Harappan culture.”

How then to explain river-facing fortifications at Kalibangan, Banawali, etc., and the proximity of major sites to channels?
Map of Harappan sites in the Ghaggar plain (Bisht & Prabhakar)
Conclusion: a possible scenario

1. A mega-river before 10000 BCE, with major contributions from the Sutlej or the Yamuna.
2. Some Higher Himalayan contributions up to 4000 BCE (Chatterjee, 2017).
3. A perennial rain-fed river during the Early Harappan phase, allowing it to flow into Cholistan at least, as noted by Mughal (1993), with a break before the Mature phase.
4. In the Mature Harappan phase (2600-1900 BCE) aridity increases, but the Sarasvati still flowed down to Anupgarh. It could also have received occasional contributions from the Sutlej and Yamuna through intermittent revivals of palaeochannels.
5. By 1900 BCE, the Ghaggar has become a seasonal foothill river — a sudden event (seismic or tectonic), two centuries of drier climate?
Prospects

- More sedimental studies are required, targeting especially the (often disturbed) sediments of the last 5,000 years.
- More geochemical studies of Harappan pottery.
- Direct dating of palaeo-waters.
- More studies of the Hakra’s course and the Rann.
- Closer crossdisciplinary collaborations, especially between geologists and archaeologists.