(2027) 55:42
https://doi.org/10.1007/s10745-026-00743-9

River Crossings at the Yangtze's Headwaters: Mapping Hydrosocial Mobility Infrastructures across the Sino-Tibetan Borderlands

Monia Chies[1]

Received: 26 November 2025 / Accepted: 16 July 2026
© The Author(s) 2026

Abstract
This article investigates river crossing spaces and practices as key features of past and present human-river relationships along the fluvial landscapes of today's Three-River-Source (TRS or *sanjiangyuan*) region of the Qinghai Tibetan Plateau (QTP), which includes the sources of the Yellow, Yangtze, and Mekong Rivers. Through an ethnographically informed analysis of Western travel literature about the Sino-Tibetan borderlands (1850–1950), this study contributes to the environmental history of the QTP by mapping the main pre-1950s river crossings within the Yangtze's headwaters region and examining how they inform contemporary state-led infrastructural and heritagization processes. This essay draws on critical infrastructure and hydrosocial theory to present river crossings as "hydrosocial mobility infrastructures" (HMIs) enabling connectivity within the wider system of historical trade routes linking China and Tibet in the headwaters region. The HMI framework highlights the ecological and relational character of pre-1950s river crossings, which are shaped by human and non-human interactions, local ecological knowledge, overlapping authorities, and frontier geopolitics, as well as by hydrological, geomorphic, and seasonal changes.

Keywords Qinghai Tibetan Plateau · Three-River-Source region · Sanjiangyuan · Yangtze River · Hydrosocial Mobility Infrastructures · Heritage · Sino-Tibetan borderlands · Ferry stations

Introduction: Moving across the Rivers of the Eastern Tibetan Plateau

> "*When drinking water remember the well-digger,*
> *when crossing a river remember the bridge-builder.*"
>
> Banner at the Drubonda ferry station in Yushu TAP.

The Three-River-Source ecological protected area (Ch. *sanjiangyuan*, henceforth TRS) of the Qinghai Tibetan Plateau (QTP), also known as China's Water Tower, includes the sources of the Yellow, Yangtze, and Mekong Rivers (Fig. 1). When it was officially designated as a national natural reserve in 2003, a ceremony was held on the east bank of the upper Yangtze at the historical ferry station of Drubonda (Tib. *gru ba'i mda'* or Ch. *zhimenda*[1]) (Figs. 1C, 2, and 3). The site is now home to the iconic two-handed TRS monument symbolizing human stewardship of the sources (Fig. 4) and demarcating the main access corridor to Jyekundo (Tib. *skye dgu mdo* or Ch. *yushu*), the county capital of the Yushu Tibetan Autonomous Prefecture (TAP) in southwest Qinghai. Because of its infrastructural development, Drubonda constitutes a key example of a cultural heritage site reflecting official narratives of modernization implemented by the Chinese Communist Party (CCP) in the Yushu TAP since the 1950s. In 1963, the construction of the first bridge at Drubonda (Fig. 5) marked the end of the centuries-long history of this ferry station connecting Yushu with the rest of China and Central Asia. This bridge was later paralleled by a second bridge and, more recently, a new highway. Future state plans also envision a hydrological station, education facilities, tourist centers, and a military post at Drubonda.

Such initiatives are best understood within the framework of the CCP's Opening to the West strategy (Ch. *xibu*

✉ Monia Chies
monia.chies@unive.it

[1] Department of Asian and North African Studies, Ca' Foscari University of Venice, Venice, Italy

[1] Tibetan terms are transliterated according to the Wylie system.

Published online: 22 October 2026

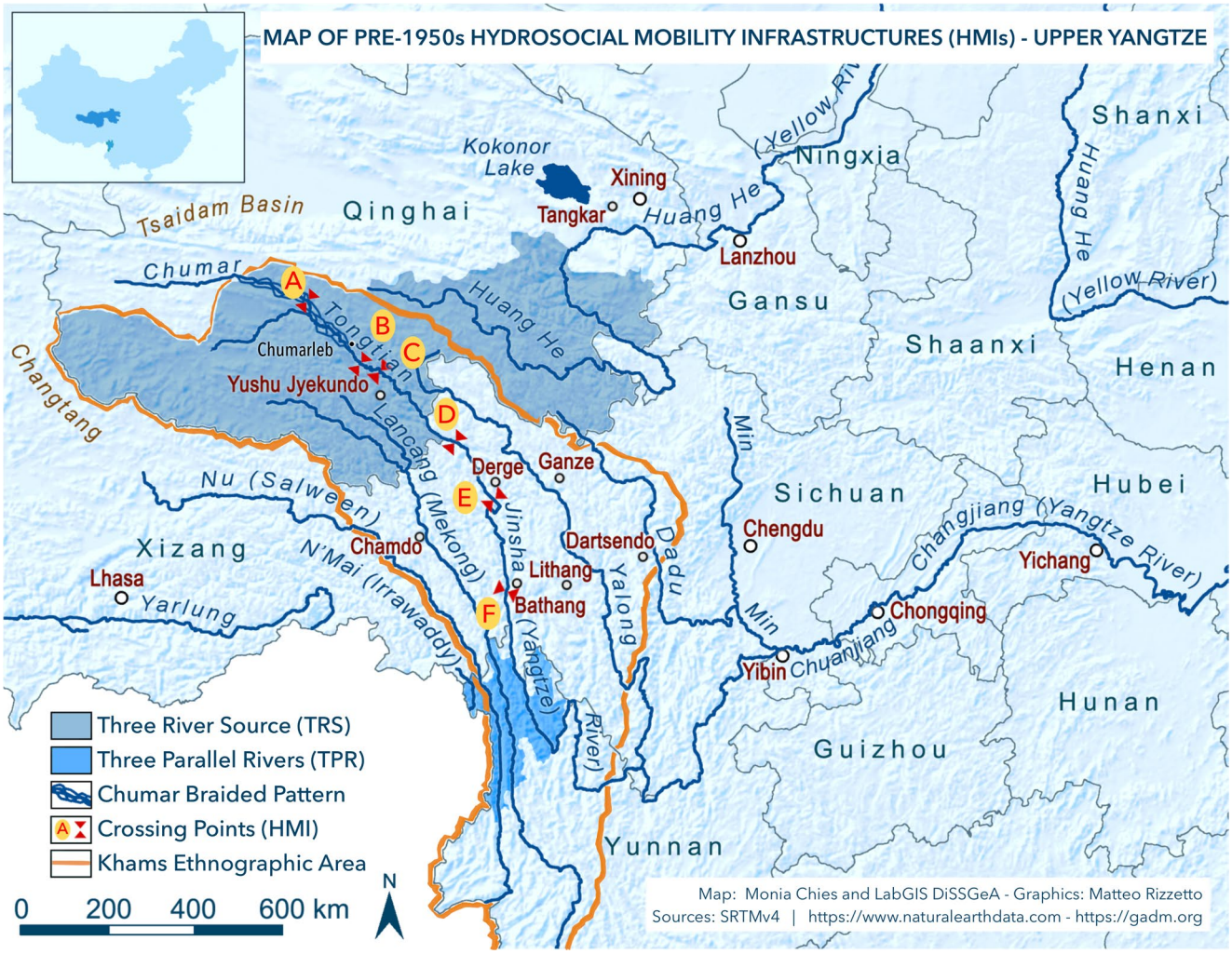

Fig. 1 Map of Pre-1950s Hydrosocial Mobility Infrastructures (HMIs) on the Upper Yangtze

da kaifa, 1999), which aims to develop China's western borderland regions through ecological protection, infrastructural renovation, and poverty alleviation in rural areas (Ptackova, 2020; Rippa, 2020). Massive state intervention in the wake of the 2010 Yushu earthquake accelerated this process (Chies, 2018), transforming New Yushu into an ecotourist destination and fostering green development and cultural heritage industries throughout Yushu TAP. Meanwhile, the TRS headwaters became a national park in 2021, and innumerable infrastructural projects including roads, bridges, and tourist and heritage sites have reshaped the way people move across the region.

Contemporary development in Yushu TAP can best be interpreted in relationship to the region's pre-1950s mobility geographies, since river crossing sites such as the Drubonda ferry and their past social actors and power dynamics underpin this development. I argue that these pre-1950s river crossings worked as predominant "hydrosocial mobility infrastructures" (HMIs) on the eastern Tibetan Plateau. This perspective contrasts with common views of infrastructure as state-built physical structures and develops an ecological understanding of pre-1950s river crossings as infrastructures emerging from the ways multiple agents inhabit and move through the plateau's land-water environments. The concept of "hydrosocial mobility infrastructures" draws on hydrosocial theory, which frames water flows, infrastructure, and social relations as co-produced through socio-natural processes in both space and time (Swyngedouw, 2009; Boelens et al., 2016). The HMI framework also utilizes critical infrastructure perspectives to foreground the ecological relational character of infrastructures (Carse, 2014) shaped by human and non-human relations (Barua, 2021). By combining historical analysis with an examination of contemporary Chinese national infrastructural and heritagization processes, this study critically reassesses the past of the eastern plateau's river crossings as cultural heritage sites connecting "peripheral and core geographies" (Read, 2025: 11).

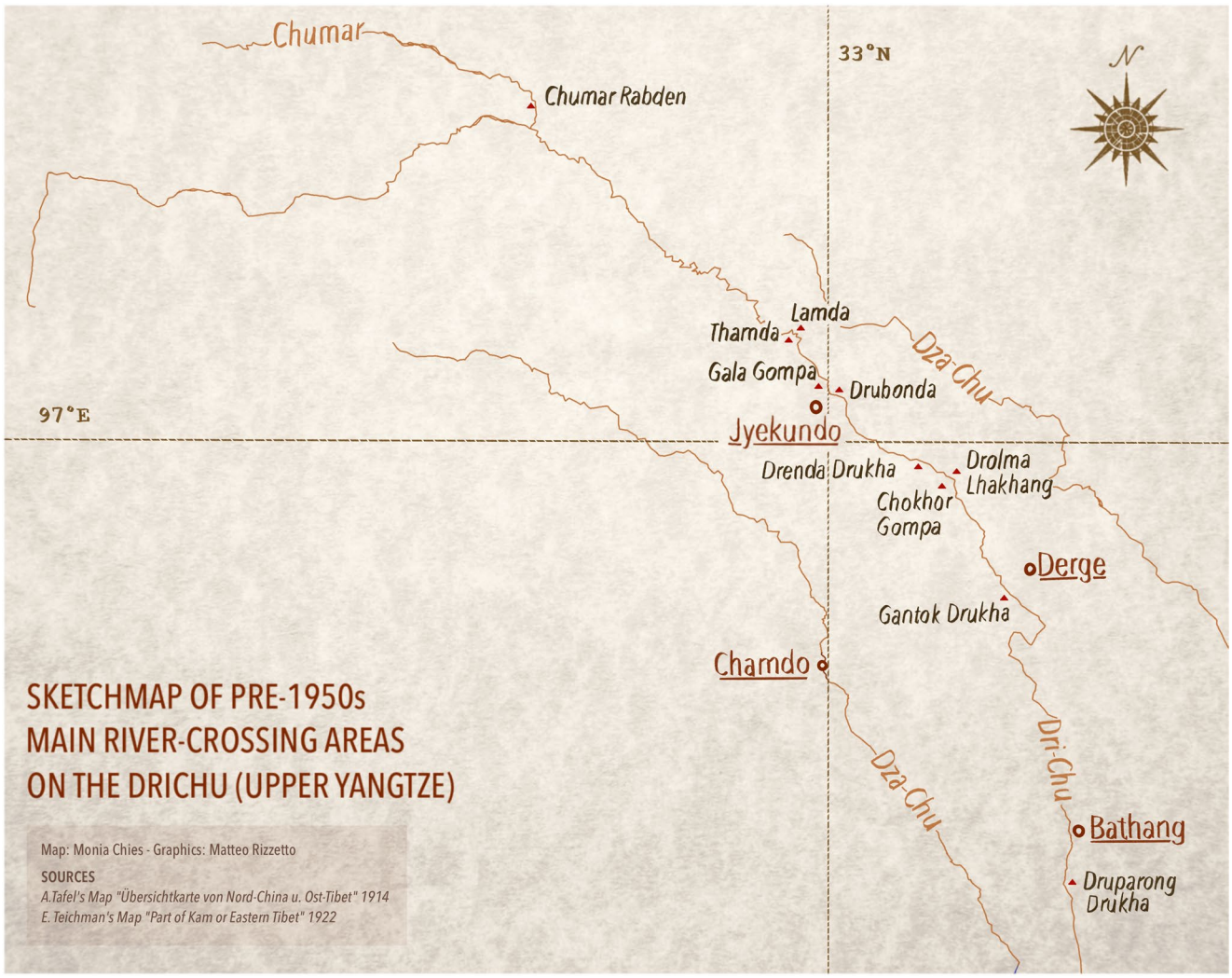

Fig. 2 Sketchmap of Pre-1950s Main River Crossing Areas on the Drichu



Fig. 3 Drubonda ferry station. Photograph taken by Monia Chies

Historically, moving across the Sino-Tibetan borderlands (STB), "the country of the great parallel rivers and the land of deep erosions" (Teichman, 1922: 193), involved dealing with the challenging topography of the plateau's highlands and the often non-navigable valleys of Asia's largest rivers. The STB encompass the Tibetan ethnographic areas of Amdo and Kham, which today extend across the Tibet Autonomous Region and the provinces of Qinghai, Gansu, Sichuan, and Yunnan in the PRC. Kham (Tib. *khams*, Fig. 1), in particular, is also referred to emically as "four rivers and six ranges" (Tib. *chu bzhi sgang drug*) or "the four great valleys" (Tib. *rong chen bzhi*), which accurately captures this region's geomorphology. Here, travelers, traders, and pilgrims journeying between China and Tibet crossed mountain paths with the aid of pack horses, yaks, mules, and human porters. They occasionally forded rivers at the few available rope or stone bridges, but more often they relied on wooden or leather boats to cross the river.



Fig. 4 TRS monument in Drubonda. Photograph taken by Monia Chies

Despite its significant role in pre-1950s water governance, the socio-historical value of the eastern plateau's river mobility infrastructure is often overlooked. To fill this gap, this study focuses exclusively on bridgeless river crossings near the Yangtze's headwaters, excluding other kinds of local hydrosocial systems (hydropower, reservoirs, pastoral water systems). By focusing on bridgeless crossing sites, this analysis challenges dominant views of rivers as linear mobility channels, emphasizing instead crosswise movement, from east to west and vice versa, through land-water interfaces. Moving crosswise, the rivers of the STB become central as both obstacles and waterways. River crossings, in turn, emerge as "social space" (Lefebvre, 1991: 33) shaped by specific human and non-human relations, practices, and confrontations that occur while moving across the region.

Through an ethno-historical lens, this article maps the four key uppermost river crossing areas of the Yangtze in the period from 1850 to 1950. I present these sites as HMIs and examine their continuities and transformations within the contemporary TRS region. Analyzing river crossings as relational contexts shifts our understanding of the environmental history of the STB by considering the specific ways Himalayan land-water relations produce space (Gagné & Rasmussen, 2016) alongside nomadic pastoral and dwelling practices (Kreutzmann, 2015; Ingold, 2000), water cosmologies (Strang, 2023), and socio-geomorphic observations (Ashmore, 2015). This study adds a crucial new infrastructural dimension to the geohistory of Kham by integrating river crossing nodes situated between major hubs into the existing analysis of the tea trade routes connecting China and Tibet (Van Spengen, 1995, 2000; Gros, ed., 2019; Booz, 2014, 2016). Finally, this study advances research on the Tibetan Plateau's rivers (Iqbal, 2026; Gamble et al., 2025), from which the Yangtze's headwaters are consistently excluded, and where ferry sites, when mentioned at all, are usually associated with specific historical events or Tibetan foundational figures like the 14th-century Thamtong Gyalpo whose iron chain suspension bridges changed Himalayan travel (Gamble et al., 2025: 123-5, 160–163), rather than examined as significant hydrosocial configurations.



Fig. 5 Concrete bridges in Drubonda. Photograph taken by Monia Chies

Methods

This article combines ethnographic research with critical analysis of travel literature about the Yangtze's headwaters between the 1850s and the 1950s. I analyze 20 early explorers' travel accounts, which provide descriptions of the region's main river crossing sites and enable systematic assessment of their past socio-environmental features. The writers examined are European, American, Canadian, and Russian travelers for whom long-distance journeys were a way of life. They include zoologists, ornithologists, botanists, doctors, and military officials tasked with producing maps and records now in archives like the Royal Geographical Society in London, as well as missionaries or adventurers guided by religious and cultural interests. While the genre is diverse, this body of literature is unified by a Western worldview with an expansionist lens.

I treat these travel accounts and maps not as neutral materials but as representations of imperial powers surveying the Tibetan ethnographic areas of Kham prior to the establishment of the People's Republic of China (PRC). Specialists in STB history view the work of Western surveyors of Kham as forms of "orientalism" (Hostetler, 2001: 99). Their knowledge production is seen as part of a "culture of display" reproducing the "world as exhibition" to fulfill specific imperial "archival myth[s]" (Mueggler, 2011: 54, 45) and nation building plans in which "geographical expertise" operated as "performance" rather than as an empirical understanding of the area (Mukherjee, 2025: 384). Nevertheless, these representations invaluably inform much STB geohistory (Van Spengen, 1995, 2000; Horlemann, 2015; Gros, 2019; Tsomu, 2024: 16).

Since Chinese gazetteers and traditional Tibetan written sources like biographies, guidebooks, and travel diaries offer limited information on river crossings, this study critically recontextualizes early travelers' accounts in light of ethnographical data. This methodological approach serves two purposes. First, the author's long-term ethnographic experience in Yushu TAP (25 months between 2010 and 2025) to research local Tibetan Buddhist pilgrimages enabled the interpretation of geographical references in these accounts, many of which would otherwise remain difficult to locate. Ethnographic experience also facilitated the translation of Chinese and Western terminology into Tibetan, the identification of toponyms and hydronyms, and the tracing of the writers' routes. Second, a preliminary ethnographic survey on river landscapes (2 months, 18 semi-structured interviews) complements early travelers' accounts by cross-checking them with contemporary residents and people from the local heritage industry whose memories and lived experience at river crossing sites enable my analysis of past and present HMIs.

Finally, by putting travel narratives in dialogue with studies of river geomorphology of the upper Yangtze conducted according to the River Styles Framework (Brierley & Fryirs, 2005), this article examines how fluvial dynamics shaped historical patterns of mobility in the headwaters region. Historical cartography, the history of long-distance trade in the STB, anthropological approaches to studying the plateau's water landscapes, and more-than-human perspectives on hydrosocial relations and water infrastructures also shape this analysis.

The Drichu: Hydronyms, Water Mobility, and Trade Routes Across the Upper Yangtze

Naming places and water bodies is never neutral (Basso, 1996). Research on early travelers' accounts requires examining toponyms and hydronyms to define the Yangtze on the map and understanding how these terms express hydrosocial relations across time and space while reinforcing particular worldviews. In Tibetan, the term "Drichu" (Tib. *'bri chu*, lit. River of the Female Yak) denotes the Yangtze River in a broad sense and encapsulates the river's Tibetan origin myth about a female yak spitting water from a rocky mountain at the headwaters. However, in Western scholarship, the hydronym Drichu is commonly rendered as "upper Yangtze" (Stein, 1972: 75; Gros, 2019: 20; Gamble et al., 2025: 176). In Chinese, the 828 km segment of the Yangtze River between the sources at the convergence of the Tuotuo River with the Dangqu River and Drubonda is referred as to "Tongtian He," while the segment between Drubonda and Yibin is officially known as "Jinshajiang" (Lu et al., 2023: 284–285) (Fig. 1). Most early Western travelers' accounts predominantly use Drichu for the headwaters area and only mention the hydronyms Tongtian He and the Mongolian "Murui-ussu." Downstream of the town of Bathang (Tib. *'ba' thang*), the travelers refer to the Yangtze as both Jinshajiang and Drichu. Their use of hydronyms may reflect their logistical and linguistic experience crossing the Drichu in areas where Tibetans and Chinese were both present in varying degrees.

A brief introduction of pre-1950s mobility across the Drichu further clarifies the scope of this study. Historically, even identifying the upper section of the Yangtze was not always easy because of diverging understandings of river drainage patterns and evolution. The main course of the Yangtze (Ch. *changjiang*) was once thought to descend directly from the Min River (Fig. 1). Today's Jinshajiang (lit. River of Golden Sand) was recognized as the upper extension of the Yangtze's main course only in the 19th century (Barbour, 1936: 19; Van Slyke, 1988: 15–16). Importantly, "the Jinshajiang runs along a deeply incised

valley through alpine ranges bordering the Tibetan Plateau, permitting shipping only on some sections by small craft" (Kim, 2020: 55). At the Druparong ferry station (Fig. 1F), travelers could cross the river without payment in "large flat-bottomed boats made and manned by Chinese soldiers" (Rockhill, 1894: 343), which carried people, goods, and animals. Further north in Bathang, described as a small valley with two hundred Tibetan families and around one hundred Chinese (Rockhill, 1894: 343), the Drichu became "navigable by skin boats or coracles, but only for short distances" (Rock, 1926: 134). Above Bathang, early travelers mainly report on river crossing via skin boats operated by Tibetan ferrymen and animals, mostly yaks, swimming across the river.

HMIs in this region are key to the history of the tea trade, which is inherently one of connections between people, goods, and places (Van Spengen, 2000: 107–119; Booz, 2016: 240–245). Yet this scholarship, which is essential for understanding crosswise mobility in the STB, has largely focused on major trade hubs and overlooked river crossings. From the 1850s to the 1950s, Kham and especially the upper Yangtze River emerged as frontier areas governed by multiple states and influenced by both local and supralocal powers. Here, tax and trade regulations and logistics are intimately tied to the dynamics of river and highland appropriation and help determine which locations along the river become most important (Giersch, 2019: 272; Gamble et al., 2025: 176). Bathang worked as both a key river crossing site and an important outpost along the central tea trade route (Ch. *guandao*, Tib. *rgya lam*) linking Dartsendo (Ch. *dajianlu* and later Ch. *kangding*) to Lhasa in Central Tibet (Carrasco, 1972 (1959): 142; Coleman, 2002).

Dartsendo (Fig. 1) sits on the eastern edge of the Tibetan Plateau adjacent to the vast Sichuanese lowlands known for tea cultivation and was the main tea trade center established in the early 18th century under the Qing court. From Dartsendo, three primary commercial corridors linked China to Tibet and broader global networks (Dutreuil De Rhins & Grenard, 1898: 378–382; Booz, 2016: 239–263; Giersch, 2019: 261, 263-4): 1) the southern routes through Yunnan; 2) the central routes from Dartsendo to Lhasa extending through today's Sichuan Province, where Lithang, Bathang, and Chamdo served as major trade hubs; and 3) the northern routes through Gansu and Qinghai. This study focuses on the northern and central corridors, examining how they connected to the trade hub of Jyekundo through the river crossing sites near the Yangtze's headwaters. Jyekundo was the uppermost trade hub of Kham, known in the premodern period as "the only town in that region where Chinese merchants are allowed to reside" (Rockhill, 1891: 206). Except for the caravan routes running through the far north Tsaidam and Changtang regions above the Yangtze's sources, all of the northern routes, which connected trade centers near the Kokonor area like Xining, Lanzhou, and Tangkar with Lhasa, went across the Drichu near Jyekundo and relied on HMIs to facilitate crosswise movement. This study restores the upper Yangtze's river crossings to the narrative of STB mobility, explaining how they enabled connectivity within these trade geographies.

River Crossings as Hydrosocial Mobility Infrastructures

American ethnologist William Rockhill depicted the Drichu as "the terrible torrent" noting that "Mongols and Chinese agreed in considering [it] the most formidable obstacle on this road" (Rockhill, 1891: 197). Early travelers describe the Drichu's water as both a barrier and a connector where multiple social actors negotiate with water flows and with each other. River crossings emerge as dynamic "socionatural" configurations in which physical and social processes are mutually constituted and inseparable, as hydrosocial scholarship foregrounds (Swyngedouw, 2009: 56). Simultaneously, river crossings work as what scholars call "ecological and relational" infrastructures, less as fixed objects than as evolving "process[es] of relationship building" within and through particular environments (Carse, 2014: 5). I therefore conceptualize the upper Yangtze's river crossings as "hydrosocial mobility infrastructures" (HMIs).

Mapping river crossings in the Yangtze's headwaters area is a fundamental analytical step rather than a purely descriptive task. Their geographical locations determine how they work as HMIs over time, across space, and in relation to fluvial geomorphology and social agents. Several key themes guide my analysis of how river crossings were identified, used, and built between the 1850s and the 1950s and how these sites are used and valued today. First, deconstructing the seemingly obvious material reality of river crossings allows differentiation among distinct HMI types and highlights their ecological dynamics. For example, in the upper Drichu, crossing sites are typically identifiable due to the presence of built environments such as ferry stations, dwellings, and religious sites, as well as simple boat moorings. However, the river crossing areas of the headwaters' scarcely populated regions, which long-distance caravans also traversed, lack these markers. What is perceivable is merely a river, complicating the journey for travelers seeking suitable crossing points. Near the river sources, a braided fluvial geomorphology means that boats are often not used to cross the river, or they are occasionally constructed on site. The plateau highlands' severe seasonal changes also impact human and non-human mobility patterns and the emergence or disappearance of HMIs. While the river's

intense summer flows entailed perilous boat crossings, a frozen river in the winter facilitated local and regional exchange, multiplying crossing locations along the upper Drichu and necessitating distinct ice-stabilizing maneuvers based on local ecological knowledge (LEK). Although this study does not primarily focus on classifying river crossings as fixed, temporary, built, or unbuilt, acknowledging these differences is essential to making pre-1950s HMIs and their complexities visible. These dynamics demonstrate how crossing sites' socio-natural and relational character unfolds actively and rhythmically within the environments of the Yangtze's headwaters and helps make evident how specific HMIs are included in contemporary state-led infrastructural development and heritagization processes.

Second, both historical and ethnographic data show that river crossing areas of the STB have developed through processes of re-territorialization. Across historical periods up to the present, upper Drichu river crossing sites have worked as trade hubs, customs checkpoints, frontier areas, and heritage sites. Pre-1950s river crossings along the upper Drichu should therefore be seen as "hydrosocial territories," that is, as "spatial configurations of people, institutions, water flows, hydraulic technology and biophysical environment that revolve around the control of water" (Boelens et al., 2016: 10). Before the 1950s, the plateau's river mobility played a key role in water governance with multiple human and non-human agents participating in managing and physically shaping HMIs. Geopolitical dynamics from the 1850s to the 1950s included local Tibetan chieftains on one side and a succession of powers controlling the Kokonor region on the other. Ruling powers in the period include the Qing Empire (1644–1911), the governments of the Republic of China (1912–1949), the Muslim Ma Lords (1915–1949), and the PRC (1949-now). Ferry stations were managed by skilled Tibetan ferrymen, competing local institutions such as Tibetan monasteries, and chieftains as well as by these overlapping supralocal powers.

Third, the early travelers exemplify how river crossings' "natural and infrastructural ecologies" converged through non-human agents on the upper Drichu (Barua, 2021:1467). For instance, at ferry stations (Tib. *gru kha*), people were transported by small leather boats while the caravan's domesticated animals, particularly yaks, were forced to swim across, oftentimes carrying their loads. Caravans' animals thus co-produced HMIs permitting river crossings. In the uppermost Drichu's braided river areas, observing wild yak mobilities provided information about viable river crossing locations and paths for travelers and caravans. Within Tibetan religious beliefs, non-human water beings (*klu*) inhabiting the river also participated in hydrosocial practices on the Drichu.

Finally, contemporary transformations of pre-1950s river crossing points into modern bridges and cultural heritage sites demonstrate how these hydro-social infrastructures work as "socio-physical constructions that are *actively and historically produced*" (Swyngedouw, 2009: 56–60, my italics). Long-established scholarship shows how today's Chinese national heritage processes mobilize regional ethnic cultures to advance development and nation building agendas (Oakes & Zuo, 2022: 423). Current infrastructural and heritage developments reshaped earlier hydrosocial infrastructures by incorporating indigenous practices and changing patterns of moving across the STB.

At the Drichu's Headwaters: From "Fordfinding" with Wild Yaks to Contemporary Ecological Protection

From here onward, this study traces river crossing places and practices beginning at the Drichu's sources and moving downstream. This section focuses on the Chumar (Tib. *chu dmar*, Red River), one of the main tributaries of the Drichu's sources (Fig. 1), demonstrating how hydrosocial infrastructures and territories near the Yangtze's headwaters have emerged within a historically contingent and fragile ecological balance between human and non-human practices.

For some early travelers, reaching the shores of the upper Drichu marked the end of their long journey or a redirection of their course (Prejevalsky, 1876: 222; Filchner, 1929: 160; De Lesdain, 1908: 316–322). For others, arriving at the Drichu's headwaters was only the beginning of discovery. Several factors impacted their journeys, including remoteness, weather, rarified air, human presence, and difficult management of caravans because of exhausted people and animals or a lack of material resources. River crossing was also influenced by wild yak behavior and changing fluvial geomorphological and hydrological patterns.

Three early accounts, by Captain M. S. Wellby and Lieut. Malcom, Ernst Schäfer, and Albert Tafel, provide particularly illuminating descriptions of fording areas on the Chumar (Fig. 2). While serving the British Survey of India, Wellby and Malcom led an expedition in 1896 to locate the Yangtze River's sources despite lacking reliable regional maps. Departing from Leh in Ladakh, the caravan followed the northern trade routes across the Changtang (Fig. 1), surveying rivers and lakes along the way. Over twelve days, they traced 120 miles of the Chumar, fording it multiple times ("Journey," 1897: 215–217). Geomorphologically, the Chumar extends from glacial valleys with a "braided pattern" (Yu et al., 2013: 820). The river flows in multiple channels that constantly merge and separate, with sandbars

and islands in between its streams (Brierley & Fryirs, 2005: 125). The Chumar river was wide and shallow and thus fordable by animal or on foot without the aid of rafts. However, the river's swift current and unstable sediments could make the crossing quite challenging (Carson Rijnhart, 1902: 240–241).

Four decades after Wellby and Malcom, Schäfer crossed the Chumar during his wild yak hunting trips. Traveling with the expedition of American naturalist Brooke Dolan (1931-34) to collect flora and fauna from the eastern plateau and equipped with better maps (Dolan, 1938: 159–184), Schäfer vividly depicts the "roaring waters of the Chumar" [2] dividing into more than fifteen branches, which would swell at night and converge by morning into a single river with a powerful current. In these circumstances, members of the expedition had to ride on horseback through the river, soaking their supplies, instruments, boxes of collected items, clothes, and most importantly, their tsampa, a Tibetan staple food (Schäfer, 1938: 219–225).

The river changes dramatically near Chumarleb (Fig. 1), where the Chumar River flows into the upper Drichu, which is here geomorphologically described as a "confined" river segment creating "a long meandering gorge" of 338 km ranging from 100 to 200 m in width (Yu et al., 2013: 822). Here, the upper Drichu was not navigable except in short stretches and could be crossed by boat at designated ferry stations and other local fordable spots. The German medical doctor Albert Tafel, who explored northeastern Tibet from 1905 to 1908, offers a remarkable illustration of river crossing in this region and describes fordable sections across both the Drichu's single channel and the Chumar's braided section. In 1905, Tafel first attempted the route from Tangkar to Lhasa via the Tsaidam Basin. His caravan arrived to the Drichu's left bank in August 1904 at a point (4200 m asl) where the river was too deep for crossing on a loaded animal's back but suitable for a ferry (Tafel, 1914: 28). Tafel directed his Tibetan caravan companions to build a raft equipped with twelve skin air bags. As preparation of the rafts was underway, an unexpected encounter disrupted this carefully planned crossing. A group of Khampa Tibetans from a nomadic tribe under the rule of Jyekundo appeared across the Drichu from Tafel's party. Despite attempts at negotiation, they concluded that Tafel's caravan, which did not have permits from the Amban in Xining, must be robbers. The party was prohibited from crossing the river, or they would face an attack. Tafel decided to leave the Yangtze valley and journey northward to the Chumar region to avoid these tribes. After crossing a few mountain passes, Tafel encountered a vast herd of more than three thousand wild yaks (Tib. *'brong*) swimming across the Chumar River. He observed that bulls sometimes went ahead to scout for optimal locations to cross the muddy terrain and, by paying attention to the locations bulls chose, found a suitable a crossing area for his caravan (Tafel, 1914: 32). This area was and still is known as "Chumar Rabden" (Tib. *chu dmar rab bdun*, lit. red water seven fords) (Figs. 1A and 2), and Tafel notes the difficulty of going across the seven large branches created when the water level had risen a few days earlier.

These early travelers' accounts provide examples of river fording across two geomorphologically different portions of the Yangtze's headwaters region and show how a thinly populated remote area was patrolled by local Tibetan tribes. In this area, wild yaks contributed to caravans' river crossing practices through "fordfinding," tracing paths for HMIs to emerge and operate at the headwaters. Alternatively, as Wellby explains, parties sometimes encountered landmarks left by previous caravans to indicate fordable areas (Wellby, 1898: 208). The historical river crossing area of Chumar Rabden is currently part of a subarea of the TRS National Park. The area is marked by a rectangular a pile of stones carved with Tibetan Buddhist mantras called mani-stones and counted among the TRS region's cultural relics (Ch. *wenwu*). Interviews carried out for my previous research on religious landmarks in Yushu TAP show that the mani-structure at Chumar Rabden is built to be parallel to the Drichu river, not perpendicular, to avoid interfering with the flow of water and the water beings (Tib. *klu*) inhabiting it. While Tibetan HMIs are now regarded as heritage sites, current TRS ecological zoning processes actively produce new hydrosocial territories impacting both human and wildlife mobility in ambivalent ways, including through the resettlement of Tibetan nomadic pastoralists (Ptackova, 2020: 7) often appointed to the new role of TRS park rangers facilitating wildlife protection (Ma et al., 2023: 6).

Managing the Drichu's Uppermost Ferry Station: Religious and Institutional Power

The uppermost ferry station on the Drichu, the Lamda ferry (Tib. *lab mda'*, Fig. 1B), demonstrates that pre-1950s river crossings functioned as dwellings as well as hydrosocial territories. At Lamda, overlapping religious, lay, local, and regional authorities competed in managing and constructing HMIs that shaped human and non-human interactions.

A key outpost along the STB's northern trade routes, the Lamda ferry is located north of Jyekundo at an altitude of 3590 m asl and includes several built infrastructures. In the early 20th century, the village of Lamda was "a corner of terrace" on the left bank of the Drichu at the confluence with its tributary the Labchu (Tib. *lab chu*). The village consisted of "a few dozen two-story houses […] with flat roofs, small

[2] Citations of Tafel and Schäfer are my translations from German.

windows and courtyards" (Tafel, 1914: 131–132), some of which were used by travelers. The Lamda ferry station was also known as Chorten Karpo (Tib. *mchod rten dkar po*), literally named for the "white stupa" rising on the left side of the Labchu, on a small cliff at the corner with the Drichu (Fig. 6). As powerful Tibetan Buddhist sites, infrastructures like stupas aided orientation and tamed land-water spirits threatening river crossing and thus stabilized HMIs. Migot links the Chorten Karpo to the 7th century Chinese Buddhist monk and translator Xuanzang (Migot, 1957: 203), who was said to have forded the river at Lamda on his way back to China. Today, locals frequently recall historical Tibetan Buddhist lamas and saints who crossed the river and performed magical deeds at the site.

In 1905, Tafel describes Lamda as a "popular ferry" for travelers and traders along the northern routes. Going through Lamda was also the shortest route for couriers between Jyekundo and Xining (Grenard, 1904: 149) and played a key role in long-distance official communication channels. For those coming from Jyekundo, the ferry station is also named after the village on the opposite bank, Thamda (Tib. *thar mda'*). The suffix "-da" (Tib. *mda'*) indicates that these villages occupy the "lower" part of the river valleys. Near Thamda, present-day villagers noted that the interior walls of an old guesthouse were covered with paper and metal labels of European, Indian, and Nepali products (Fig. 7), highlighting the ferry site's historical role as a global trade hub facilitating the movement of people and goods. At a local level, travelers describe Lamda as an agricultural area featuring lush, swampy meadows and fields where monks and villagers cultivate wheat and barley, all nestled within the embrace of the Yangtze's mountain ridges (Duncan, 1952: 215; Schäfer, 1938: 131).

Management of the Lamda ferry shifted among different institutions over time. Recent interviews with locals explain that the ferry station was managed by two competing parties, the Lamda household that owned most of the leather boats and the Lab monastery (Tib. *lab dgon*) that built the site's first wooden boat in the early 20th century. Lamda was the only pre-1950s ferry station on the upper Drichu operating both leather boats and a wooden ferry, which was a sizable "barge" and made multiple trips over the course of a day to move people and goods through the river's challenging current (Duncan, 1952: 207). Geopolitically, the Lamda ferry was under the rule of the Jyekundo chieftain and part of the kingdom of Nangchen. Simultaneously, it was supervised by the Xining Ambans under the Qing rule (1720s–1911) and, later, under the Muslim Ma Lords (1913–1949). Because of these competing investments, the Lamda ferry functioned as a hydrosocial checkpoint where local and supralocal powers overlapped.



Fig. 7 Trade labels displayed near Thamda advertising synthetic dyes and raw cotton companies. Photographs taken by Monia Chies

Travelers passing through Jyekundo at the end of the 19th century consistently report on the Lamda ferry station's role as a fraught connection point between travelers and official institutions. For example, in 1894, the crossing at Lamda served as basecamp for the explorer Fernand Grenard, who



Fig. 6 View of Chorten Karpo at the confluence between the Drichu and its tributary the Labchu. Photograph taken by Monia Chies

journeyed into eastern Tibet to explore the Mekong headwaters with J. L. Dutreuil de Rhins as part of a scientific mission assigned by the French Minister of Instruction. Unfortunately, Dutreuil de Rhins was killed by gunshot at a village between Jyekundo and the right bank of the Drichu. At Lamda, Grenard received assistance from the Lab monastery lamas while he was detained for about twenty days near the site by Tibetan and Chinese officials who were clarifying the incident and attempting to recover Grenard's caravan, which was partially restored, and the remains of the French traveler, which were never found (Grenard, 1904: 150–189).

The Dolan-Schäfer-Duncan expedition in the 1930s provides another example of how overlapping powers operated in Lamda: after their party crossed the river, an official of General Ma halted progress, forcing members of the caravan to separate to secure permits from Xining and Jyekundo for hunting wild animals in the area (Schäfer, 1938: 114–117). Schäfer's account also provides insight into the non-human dimension of the ferry crossing, describing domesticated yaks (Tib. *g.yag*) as the best swimmers among Tibetan ungulates (Schäfer, 1938: 114). Forced to swim across the river, the yaks initially resisted. Ferrymen then drove them into the current with stones, and the yaks showed remarkable ability to stay together and float thanks to their thick winter fur. When crossing the Chumar River, wild yaks led humans in fordfinding; at the Drichu ferry stations, however, ferrymen and caravanners compelled pack animals to swim at designated spots. In both cases, wild and domesticated animals co-produce HMIs with humans, facilitating movement across the STB.

The travelers' pre-1950s accounts portray the Lamda ferry as the most dynamic upstream site of hydrosocial control, serving as a dwelling site, religious center, customs post, regional checkpoint, and trade hub within a broader network of routes from Gansu and Xining. At present, the ferryman's house at Lamda has been restored as a heritage site, and a concrete bridge connects the riverbanks near the Chorten Karpo, which remains a key pilgrimage site for Tibetan Buddhists and is mainly reachable from the road flanking the river from Drubonda.

Boats, Ferries, and Ferrymen: Past and Present Representations

This section examines current official narratives around boats, ferries, and ferrymen of the TRS alongside early travelers' accounts to highlight elements of continuity and change in the mobility geographies and representations of pre-1950s HMIs on the upper Drichu. About 35 km downstream of Lamda, where leather boats and a wooden ferry coexisted, lies the Drubonda ferry. As this article's introduction outlines, today Drubonda hosts Jyekundo's main entrance bridges and the TRS monument made of 56 granite blocks reflecting China's 56 ethnic minorities and with "Sanjiangyuan Nature Reserve" handwritten by President Jiang Zeming ("Sanjiangyuan"). Alongside the monument, the ferryman's house at Drubonda also serves as an official cultural heritage site. Contrary to the Lamda ferryman's house, which is presented as a traditional Tibetan multi-story house, the Drubonda ferryman's house displays a life-size model of a square leather boat surrounded by wall-mounted plaques bearing state narratives (Fig. 8). Old photos commemorate CCP officials' use of the ferry in the 1950s and the building of the first concrete bridge on the Tongtian He in 1963. This display shows how, at Drubonda, state-led heritage-making processes mobilize Tibetan material culture and social practices as a past that laid the ground for current modernization and national ethnic unity on the plateau (Ch. *gaoyuan minzu tuanjie*).

Both local interviews and the early travelers' narratives depict Drubonda as a more minor ferry site than Lamda. The narratives rarely mention the toponym Drubonda, which has to be inferred from the descriptions of surrounding power centers, such as the Zheu monastery (Tib. *zhe'u dgon*). More frequently, this crossing area is associated with the Gala monastery located on the opposite bank in the homonymous village, a few kilometers upstream in an internal valley near the Yangtze River (Teichman, 1922: 94). The term Gala (Tib. *'gag la*) indicates a narrow physical passage across steep mountains and reflects both the local geomorphology and the village's role as territorial barrier or checkpoint leading directly to Jyekundo through the high pass of Ra La (4390 m asl). Travelers often stopped in Gala overnight. Annie Taylor, an English Evangelical missionary for the China Inland Mission, was the first Western woman to visit this part of the eastern plateau with her own caravan. On her way to Lhasa in 1893, Taylor met the chief of the Zheu monastery, crossed at Drubonda on a skin boat, and stayed at Gala in a hillside home with living spaces, a guest room, a prayer room for the lamas, and winter grain stored



Fig. 8 Yak-leather boat displayed at the ferryman's house in the Drubonda village. Photograph taken by Monia Chies

on the roof (Taylor, 1895: 26). Due to the Drichu valleys' geomorphic variations, the HMI serving the narrow valley of Drubonda was a multi-site arrangement, where the main power centers, the Gala and Zheu monasteries, were represented as a single functional node together with the ferry station, despite being located at separate sites. Today, the road from the Drubonda bridge to Jyekundo skirts around the Ra La mountain pass, disrupting the historical spatial configuration of this hydrosocial node and privileging Drubonda over other major historical river crossings such as Lamda.

In travel literature across the STB, representations of boats, ferries, and ferrymen are recurring elements of the narrative. Pre-1950s river crossings appear as both obstacles and strategic connection points, working as liminal time-spaces with transformational effects. In fact, river crossings were potentially life-threatening sites requiring careful evaluations of water and weather conditions, which could endanger the entire expedition. Similar to rites of passage (Van Gennep, 1981), the early travelers' narratives divide river crossings into three phases: (1) the arrival at the river; (2) the actual crossing; and (3) the departure. In high-risk and unfamiliar circumstances, writers condense the experience of river crossing to the scale of the boat as in the case of French explorer André Migot:

> "On wide rivers like the Yalung or the Kinchakiang [Jinshajiang] you use extraordinary dinghies or coracles made of hide which are really big round wickerwork baskets covered with yak-skins deftly sewn together. The middle of the circular "hull" is about six feet across, but the mouth […] and the bottom of the basket are considerably narrower. Into it you pile men and merchandise, and the vessel, launched upon the flood, is steered by a helmsman with a long wooden paddle. The voyage is seldom dull, for the coracle spins round and round and rocks violently in rough water or eddies; It has, however, greater stability that its appearance suggests. The current is so strong that you may be carried five hundred yards downstream before you reach the other side, in spite of the efforts of the helmsman." (Migot, 1957: 134).

In this iconic quotation, Migot offers insight into the material and structural features of round leather boats and their usage. The powerful current on rivers of the STB made skin boats spin around, producing diagonal shifts as the boats moved from one bank to the other. This geometry of river crossing contrasts with more linear crossings on wooden boats. In Migot, the leather boat's diagonal path results in a half-mile trek downstream, forcing the boatsmen to walk back upstream while balancing the boat atop their heads after the crossing is complete. This trajectory would by typical for leather boats navigating the Yangtze's current. While early explorers only describe ferrymen's navigational maneuvers and dealings, ethnographic research on fishing in Central Tibet extensively explores the role of ferrymen within the pre-1950s Tibetan tax system and analyses leather boats as material culture (Altner, 2009; Lange, 2023). In the STB, travel accounts also highlight how, during conflicts, Tibetans disrupted connections by removing boat services at key crossing sites and suspending land transportation networks like *ulags* (Tib.*'ulag*)[3] to prevent enemies from advancing or to encourage negotiations across the frontier areas of Kham (Coales, 1919: 246; Teichman, 1922: 73).

Examining the historical significance of ferrymen and leather boats demonstrates their roles in building connectivity across the STB and their current importance in nation building narratives. The contrasting processes of modernization at Lamda and Drubonda also reveal how current infrastructural systems reshape the hierarchies of HMIs and fail to reflect historical geographies of mobility.

Frozen Rivers and Seasonal Shifts on the Upper Drichu

Despite the overlapping systems regulating ferry sites, seasonal changes greatly affected river crossing spaces and practices on the upper Drichu further highlighting the role of religion and non-human agents in managing HMIs. Focusing on the river segment between Lamda and Drubonda, this section delves into how seasonal shifts could disrupt or reinforce established community relationships and boundary rules, cyclically reconfiguring hydrosocial infrastructures and territories. Like most major rivers of the eastern Tibetan Plateau, the upper Drichu experiences significant variation in water volume with substantial fluctuations in summer and partial freezing in winter, all of which reshape modes and locations for river crossings and their human and non-human hydrosocial relations. Interviews with locals reveal that wintertime intensified exchange between villages on the two sides of the Drichu including through intermarriage, local trade, and pilgrimage. During winter, locals also employ LEK strategies to create frozen paths across the river, using wood to alter local water conditions and foster freezing.

Early travelers' accounts likewise detail ice-induced mobility variations at pre-1950s ferry sites. In February 1905, on his second attempt to travel from Tangkar to Lhasa, the Jyekundo chieftain denied Albert Tafel crossing at the Lamda ferry. Later, Tafel learned that the drift ice of the Drichu had accumulated downstream creating an ice bridge

[3] Corvée transport provided by locals.

that connected the two banks. Unlike the Lamda ferryman, the residents of the small settlement near the ice bridge did not inquire about Tafel's permission to cross the river. Instead, they charged a small fee to walk with Tafel on the ice and show him the most stable ice blocks for crossing safely. The travelers thus successfully circumvented the Lamda checkpoint thanks to the alternative winter river mobility option available at a temporary and unmonitored crossing area. The ice bridge, in turn, offered seasonal opportunities for income to the local community. Tafel notes that while he walked the 150-meter-wide ice bridge, local guides recited prayers (Tafel, 1914: 134). As in Fig. 9, the path across the frozen river was marked by two rows of mani-stones bearing the Avalokitesvara mantra carved on a red backdrop and set into the ice to connect the banks and symbolically secure the bridge by pacifying the water spirits. Today, the Tibetan Buddhist ritual of ephemeral "holy bridges" (Tib. *dpe zam* or *gser zam*) (Fig. 10) on the upper Drichu is still practiced with both mani-stones and sand mantra inscriptions.

In Drubonda, an ice bridge formed close to the ferry station, facilitating river crossing but maintaining the same level of mobility check for travelers crossing by boat or ice



Fig. 9 Mani-stone bridge on ice and stone carvers working on inscriptions along the Bathang river, a tributary of the Yangtze in Jyekundo. Photograph taken by Monia Chies



Fig. 10 Mantra inscriptions on ice on the Bathang river, a tributary of the Drichu in Jyekundo. Photograph taken by Monia Chies

bridge. Schäfer's account of multiple crossings at Drubonda further explains the seasonal shifts in the area. In March 1935, the Drichu was frozen, and Schäfer's party crossed the river in the morning when the ice was compact enough to support their yak caravan. Here, too, mani-stones were embedded into the ice to dispel water spirits and ensure the bridge's safety (Schäfer, 1938: 91). While winter shifts typically eased the passage at the Drubonda ferry, the summer presented a treacherous period where people and animals involved in river crossing faced significant challenges. In the summer of 1935, Schäfer faced his toughest river crossings while traveling from Jyekundo to Dartsendo. The Drichu, twice its usual width, roared with swollen waters, and Schäfer knew the expedition's success depended on getting his two caravans across. Monks were called to pacify the water spirits, and most yaks reached the opposite bank, though a few perished (Schäfer, 1938: 271).

Focusing on how seasonal hydrological cycles and river geomorphology impact river mobility demonstrates that here, contrary to common perceptions of infrastructures as fixed and unchanging, HMIs shift in time and space. Tibetan populations align human river crossing practices with the rhythms of nature through LEK strategies, including Tibetan Buddhist rituals to stabilize the hydrosocial relations between humans and non-humans across water and ice bridges.

Hydrosocial Mobility Infrastructures and the Sino-Tibetan frontier

According to the early travelers, more interconnected river crossing sites situated further downstream from the Yangtze's headwaters formed a continuum with upstream HMIs connecting to Jyekundo, albeit with differing religious and

economic significance. Moving 100 km along the Drichu from Drubonda, Denkhog (Tib. *ldan khog*) was a fourth major river crossing area (Fig. 1D). This ferry site was historically part of the Derge kingdom (Tib. *sde dge*) and is located in today's northwest Sichuan Province (Fig. 1). Denkhog sits outside of the TRS at the border with the Tibet Autonomous Region (TAR) and is linked to both Jyekundo and key downstream river crossings of the Sino-Tibetan frontier, which are distinguished by their strategic importance and form a distinct set of hydrosocial border territories. Based on his military experience as a British diplomat in eastern Tibet, Teichman places Denkhog on his list of the three main crossing areas on the upper Drichu regularly used by both Tibetan and Chinese army troops, some of which are also known for being perilous spots for pillaging (Rockhill, 1894: 343, Teichman, 1922: 134, 158). In upstream order, as shown in Figs. 1 and 2, Teichman names (a) the "Drubanang" or Druparong Drukha (Tib. *gru pa rong*, Fig. 1F), located on the east bank of the Drichu below Bathang; (b) the Gantog Drukha (Tib. *skam thog gru kha*, Fig. 1E), an extremely narrow valley located on the west bank of the Drichu near Derge, which connects with Ganze to the east and Chamdo to the west; and (c) the Drenda Drukha (Tib. *'dren mda' gru kha*) in Denkhog, connecting to the central routes in Chamdo and also to Jyekundo and the northern routes. Although early travelers noted a stronger Chinese presence in Denkhog than upstream, compared to downstream ferry stations, Denkhog was less patrolled, with Chinese troops only seen passing through.

Three architectural elements often emerge from travel reports about Denkhog. They demonstrate how Tibetan foundational sacred geographies and frontier geopolitics converge at the site. First, accounts describe the renowned temple of Drolma Lhakhang (Tib. *sgrol ma lha khang*) (Fig. 11). Established in the 7th century, at the time when Buddhism was introduced in Tibet, the temple became a key geomantic point on the STB, pinning down the right palm of the "supine demoness" who lies across the land of Tibet (Stein, 1961: 73; Gyatso, 1987). Second, travelers describe the Adu Phodrang (Tib. *phobrang*, lit. palace), a multi-story wooden building featuring an inner courtyard where the local chieftain Adu Pön (Tib. *dpon*) lived and served under the Derge King. Third, accounts identify a Chinese yamen, a government office that, as Teichman notes, was constructed during the late Qing era during Zhao Erfeng's military campaigns in Kham (Coleman, 2002: 49) The office served as the residence of a daotai, a Qing official who was meant to oversee the nomadic populations of these northern areas. In 1917, the yamen stood as the sole Chinese structure in this part of upper Kham and functioned similarly to the yamen of Bathang, which governed the southern districts (Teichman, 1922: 84−6).



Fig. 11 Main gate of the Drolma Lhakhang in Denkhog. Photograph taken by Monia Chies

Alongside these overlapping institutions, HMIs were organized around two ferry points leading to different destinations. First, Chomdo (Tib. *chos mdo*,) is located directly opposite Denkhog, near the Chokhor monastery (Tib. *chos 'khor dgon pa*) at the confluence with the Cho River, which is flanked by a road connecting to the main central routes through Chamdo and Bathang (Tafel, 1914: 165). Further upstream on the right bank lies the Drenda Drukha, which serves the main trade route between Dartsendo and Jyekundo (Teichman, 1922: 85). The riverbed narrows at this point and freezes during winter, allowing travelers to cross on foot in just "180 paces" at various sites nearby (Hennessey, 1884: 59).

Denkhog's lower altitude (3400 m asl) contributed to its economic and geopolitical importance. As indicated by the syllable *khog*, which describes "the interior of something" (Huber as cited in Thargyal, 2007: 33), Denkhog was a "mountain-encircled" agricultural area, which, compared to the upstream agricultural valleys of the Lamda and Drubonda ferries, allowed for the cultivation of diverse crops beyond barley, including wheat, pease, pulse, mustard seed, turnip, and radish (Hennessey, 1884: 59). Early travelers also highlight broader networks and patterns of trade at Denkhog. At

upstream ferries, accounts focused on caravans being split and animals crossing the river by swimming, which was also common in Denkhog (David-Néel, 1980 (1933): 478). At Denkhog, however, Tafel also observes the preparation of a large caravan of yaks to transport tea like in major trade hubs. Upon arriving on the Drichu at Chomdo, Tafel observes walls of tea bricks, each equaling half a yak load, waiting to be carried to central Tibet by 800 oxen arriving from Jyekundo (Tafel, 1914: 165). In her 1899 account, the Canadian missionary Susie Carson describes connections with other transport services. She waited at Denkhog for a fresh *ulag*, a local corvée transport service, which usually changed over at river crossing sites on the STB (Pereira & Younghusband, 1925: 139). After losing her son and husband en route between the Yangtze and Mekong Rivers, Carson was denied transport by the ferrymen in Denkhog due to the absence of *ulag* service on the other side of the river, forcing her to stay in a nearby village for two days. She had ridden from Jyekundo to the Drichu in a small caravan of yaks, but in Denkhog, Carson's new *ulag* was composed of donkeys, which were more commonly utilized on that side of eastern Tibet. Carson paid a fee for crossing the river, whereas other passengers exchanged goods like butter, cheese, and tea, which led to disputes with the ferryman (Carson Rijnhart, 1902: 363–365).

Today in Denkhog, the Drichu continues to mark the boundary between Sichuan Province and the TAR (Fig. 12) and features two bridges, one concrete and one iron (Fig. 13). While the Drolma Lhakang is a renowned Tibetan Buddhist pilgrimage site, Denkhog functions more as a transit area than a tourist destination. Historically, the Denkhog ferry illuminates broader scalar relationships among the larger and smaller HMIs reflecting differing degrees of power along the upper Drichu. While their marginal or central roles shifted in response to seasonal changes, military conflicts[4], and overlapping institutions, historical HMIs also served as blueprints for contemporary state infrastructure development, which has reconfigured their scalar relations, cultural values, and spatial hierarchies.

Conclusion

This study has explored the upper Yangtze's river crossings as long-standing HMIs connected to ongoing state-led ecological and infrastructural developments in the TRS region. River crossing sites' cultural value and mobility geographies are incorporated into and mobilized by contemporary socio-economic development processes. Historically, the upper Yangtze's river crossings have served as significant



Fig. 12 Circumambulation path around the Drolma Lhakhang in Denkhog on the historical STB. Photograph taken by Monia Chies



Fig. 13 Iron bridge in Denkhog. Photograph taken by Monia Chies

HMIs facilitating crosswise mobility and transforming the river into a nearly ritualistic space of action and exchange in which humans, non-humans, things, and river landscapes worked together in novel ways. The HMI framework highlights the ecological, relational, and shifting character of the upper Yangtze's pre-1950s river crossing sites, which might have functioned as trade centers while not officially holding the same status as major trade hubs or served as territorial checkpoints patrolled by local tribes even in the thinly populated areas near the headwaters. Further downstream on the Drichu, ferry stations featured boat services organized within built environments including customs offices, religious sites, and agro-pastoral villages, all of which reflected overlapping local and supralocal powers. Near the Yangtze's headwaters, seasonal shifts combined with human and non-human agents like wildlife, domesticated animals, and water deities cyclically reshaped the hydrosocial territories around these crossing sites. The headwaters region's HMIs sit within fluid border zones continuous with the broader Sino-Tibetan frontier shaped by the Drichu river downstream, thereby illustrating how HMIs and border formation processes intertwine across regional and national scales.

[4] See the case of Rongbatsa (Teichman, 1922: 161) or the case of Gantog in 1932 (Gamble et al., 2025: 182).

Acknowledgements The early travellers have been my research companions through the Covid-19 pandemic, maternity leave, and my return to academia. Earlier versions of this article were presented at international conferences, including "Life along the River" (Columbia University, 2021) and WaterWays Workshop (Ca' Foscari University, 2024), and benefited from discussions at these venues and at university seminars. I am deeply grateful to my MSCA supervisors, Francesco Vallerani and Gary Brierley, for their encouragement, and to the Tibetan people of Yushu for their generosity, hospitality, and invaluable support during my fieldwork. My special thanks go to Julia Dauer for her careful writing support and proofreading, to Matteo Rizzetto and LabGIS DiSSGeA for their assistance with the maps, and to Lucia Galli and the peer reviewers for their thoughtful suggestions. Any remaining errors are, of course, my own.

Author Contributions I am the sole author of this article.

Funding This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie Action "Global Dynamics of Hydro-Sociality in River Heritage Landscapes of the Qinghai Tibetan Plateau- HYSOTIB." Grant Agreement N.839511. The preparation of the manuscript was also supported by the Marie Curie PlusOne 1-year grant awarded by Ca' Foscari University of Venice (2024-2025) and finalized during the ongoing Young Researchers MSCA Fellowship "Inhabiting the Three-River-Sources: An Ethnographic Study -ETHNORIVER" funded from the European Union Next-Generation EU - National Recovery and Resilience Plan (NRRP), Mission 4 - Component 2- Investement 1.2 - CUP N.H73C24002010001. This manuscript reflects only the author's views and opinions, neither the European Union nor the European Commission can be considered responsible for them.

Data Availability No datasets were generated or analysed during the current study.

Declarations

Competing interests The authors declare no competing interests.

Clinical Trial Number Not-applicable.

Open Access This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by-nc-nd/4.0/.

References

Ashmore, P. (2015). Towards a sociogeomorphology of Rivers. *Geomorphology*, *251*, 149–156. https://doi.org/10.1016/j.geomorph.2015.02.020

Altner, D. (2009). *Die Verkleinerung der Yakboote.Fischerkulturen in Zentral- und Südtibet im sozioökonomischen Wandel des modernen China*. Harrassowitz Verlag.

Barbour, G. B. (1936). Physiographic History of the Yangtze. *The Geographical Journal*, *87*(1), 17–32.

Barua, M. (2021). Infrastructure and non-human life: A wider ontology. *Progress in Human Geography*, *45*(6), 1467–1489. https://doi.org/10.1177/0309132521991220

Boelens, R., Hoogesteger, J., Swyngedouw, E., Vos, J., & Wester, P. (2016). Hydrosocial Territories: A political ecology perspective. *Water International*, *41*(1), 1–14. https://doi.org/10.1080/02508060.2016.1134898

Booz, P. (2014). In and out of borders: The 'Beifu'背夫 Tea Porters Encounter Tibet. *Cahiers d'Extrême -Asie, 23*, 253−69.

Booz, P. (2016). To control Tibet, first Pacify Kham: Trade Routes and Official Routes (guandao) in Easternmost Kham. *Cross-Currents: East Asian History and Culture Review*, *5*(2), 239–263. https://doi.org/10.1353/ach.2016.0008

Brierley, G. J. & Fryirs K. A. (2005). *Geomorphology and River Management: Applications of the River Styles Framework*. Blackwell Publishing.

Basso, K. H. (1996). *Wisdom Sits in Places: Landscape and Language among the Western Apache*. University of New Mexico Press.

Carrasco, P. (1972). *Land and Polity in Tibet*. University of Washington Press. (Original work published 1959).

Carse, A. (2014). *Beyond the Big Ditch: Politics, Ecology, and Infrastructure at the Panama Canal*. Massachusetts Institute of Technology Press. https://doi.org/10.7551/mitpress/9780262028110.001.0001

Carson Rijnhart, S. (1902). *With the Tibetans in Tent and Temple Narrative of Four Years' Residence on the Tibetan Border, and of a Journey into the Far Interior.* Oliphant, Anderson & Ferrier.

Chies, M. (2018). Post-Disaster Development Among Yushu Peri-Urban Nomads: Local Agency, Risk Perception and Legal Framework (Qinghai Province, PRC). *Nomadic Peoples, 22*, 222–248. https://doi.org/10.3197/np.2018.220204

Coales, O. (1919). Eastern Tibet. *The Geographical Journal*, *53*(4), 228–249.

Coleman, W. M., IV. (2002). The uprising at Batang: Khams and its significance in Chinese and Tibetan History. In L. Epstein (Ed.), *Khams pa Histories: Vision of People, Place and Authority* (pp. 31–56). Brill.

David-Néel, A. (1980). *Au Pays des Brigrands Gentilshommes*. Librairie Plon. (Original work published 1933)

De Lesdain, C. (1908). *Voyage au Thibet. Par la Mongolie de Pékin aux Indes.* Librairie Plon.

Dolan, B. II. (1938). Zoological Results of the Second Dolan Expedition to Western China and Eastern Tibet, 1934–1936 Part 1, Introduction. *Proceedings of the Academy of Natural Sciences of Philadelphia*, *90*, 159–184.

Duncan, M. H. (1952). *The Yangtze and the Yak. Adventurous Trails In and Out of Tibet.* Edwards Brothers, INC.

Dutreuil De Rhins, J. L. (1898). *Mission Scientifique dans la Haute Asie 1890–1895.Deuxiéme partie Le Turkestan et le Tibet Étude ethnographique et sociologique par F. Grenard.* Ernest Leroux Editeur.

Filchner, W. (1929). *Om Mani Padme Hum. Meine China und Tibetexpedition 1925/28*, F. A. Brockhaus.

Gagné, K., & Rasmussen, M. B. (2016). Introduction - An amphibious anthropology: The production of place at the confluence of land and water. *Anthropologica*, *58*(2), 135–149. https://doi.org/10.3138/anth.582.T00.EN

Giersch, C. P. (2019). The Origins of Disempowered Development in the Tibetan Borderlands. In S. Gros (Ed.), *Frontier Tibet: Patterns of Change in the Sino-Tibetan Borderlands* (pp. 255–280). Amsterdam University Press.

Gamble, R., Tan, G. G., Xu, H., Beavis, S., Maurer, P., Pittock, J., Powers, J., & Wasson, R. J. (2025). *Rivers of the Asian Highlands: From Deep Time to Climate Crisis*. Routledge. https://doi.org/10.4324/9781003392033

Grenard, F. (1904). *Tibet: The Country and its Inhabitants*. (A. Teixeira De Mattos, Trans.). Hutchinson & Co. (Original work published 1898)

Gros S. (Ed.). (2019). *Frontier Tibet. Patterns of Change in the Sino-Tibetan Borderlands*. Amsterdam University Press.

Gyatso, J. (1987). Down with the demoness: Reflection on a feminine ground in Tibet. *The Tibet Journal*, *12*(4), 38–53.

Hennessey, J. B. N. (1884). *Report of the Explorations in Great Tibet and Mongolia. Made by A–K in 1879-82 in Connection with the Trigonometrical Branch, Survey of India*. Trigonometrical Branch Office, Survey of India.

Horlemann, B. (2015). A Bibliographic Note and Table on Mid-19th to Mid-20th Century Western travelogues and research reports on Gansu and Qinghai. In G. Roche, K. Dede, F. Pirie, and B. Copps (Eds.), *Asian Highland Perspectives 37. Centering the Local. A Festschrift for Dr. Charles Kevin Stuart on the occasion of his Sixtieth Birthday* (pp. 37–78).

Hostetler L. (2001). *Qing colonial enterprise: Ethnography and cartography in early modern China*. University of Chicago Press.

Ingold, T. (2000). *The Perception of the Environment: Essays on Livelihood, Dwelling and Skill*. Routledge.

Iqbal, I. (2026). *The Range of the River. A Riverine History of Empire across China, India and Southeast Asia.* Stanford University Press.

Journey of Captain Wellby and Lieut. Malcom across Tibet. (1897). *The Geographical Journal, 9*(2), 215–217.

Kim, N. (2020). *Mountain rivers, mountain roads: Transport in southwest China 1700–1850*. Brill.

Kreutzmann, H. (2015). *Pamirian Crossroads: Kirghiz and Wakhi of High Asia* (1st ed.). Harrassowitz Verlag. https://doi.org/10.2307/j.ctvc76zjf

Lange, D. (2023). My karma selected me to become a ferryman. The role of waterways and watercraft in the corvée tax system in pre-1959 Tibet. In A. Travers, P. Schwieger, & C. Ramble (Eds.), *Taxation in Tibetan Societies: Rules, Practices and Discourses* (pp. 197–210). Brill.

Lefebvre, H. (1991). *The Production of Space*. Blackwell. (Original work published 1974).

Lu, J., Zhu, Y., Jin, Z., Guo, X., Guo, C., Peng, C., Wang, Y., Hu, C., & Yuan, Y. (2023). Evolution of the main channel of the Yangtze River. *River IWHR Wiley*, *2*(3), 283–306. https://doi.org/10.1002/rvr2.52

Ma, T., Swallow, B., Foggin, J. M., Sang, W., & Zhong, L. (2023). Developing co-management for conservation and local development in China's national parks: findings from focus group discussions in the Sanjiangyuan Region. *Frontiers in Conservation Science*, *4*, 903788. https://doi.org/10.3389/fcosc.2023.903788

Migot, A. (1957). *Tibetan Marches*. (P. Fleming, Trans.). Penguin Books. (Original work published 1954)

Mueggler, P. (2011). *The paper road: Archive and Experience in the Botanical Exploration of West China and Tibet*. University of California Press.

Mukherjee, S. (2025). An expert in the field: Discovering the traditional borders of Late-Qing Geo-knowledge in the Himalayas. *Journal of Chinese History*, *9*(2), 379–403. https://doi.org/10.1017/jch.2025.10044

Oakes, T. & Zuo, Z. (2022). Remoteness and connectivity: The variegated geographies of the Yunnan-Guizhou Plateau. In J. J. P. Wouters & M. T. Heneise (Eds.), *Routledge Handbook of Highland Asia* (pp. 418–429). Routledge. https://doi.org/10.4324/9780429345746

Pereira, C. & Younghusband F. (Ed.). (1925). *Peking to Lhasa:The Narrative of Journeys in the Chinese Empire made by the late Brigadier-General George Pereira.* Constable and Company LTD.

Prejevalsky, N. (1876). *Mongolia, The Tangut Country and the Solitudes of Northern Tibet, Vol. 1*. (D. Morgan, Trans.). Sampson Low, Marston, Searle, & Rivington. (Original work published 1875)

Ptackova, J. (2020). *Exile from the Grasslands: Tibetan Herders and Chinese Development Projects*. University of Washington Press. https://doi.org/10.6069/9780295748207

Read, A. (2025). Infrastructure as archive: Examining the colonial geographies of rivers. *Transactions of the Institute of British Geographers*, *50*(4), e70020. https://doi.org/10.1111/tran.70020

Rippa, A. (2020). *Borderland Infrastructures: Trade, Development and Control in Western China*. Amsterdam University Press. https://doi.org/10.5117/9789463725606

Rock, J. F. (1926). Through the great river trenches of Asia. *The National Geographic Magazine*, *L*(2), 133–186.

Rockhill, W. W. (1891). *The Land of Lamas. Notes of a Journey Through China Mongolia and Tibet.* The Century Co.

Rockhill W. W. (1894). *Diary of a Journey through Mongolia and Tibet in 1891 and 1892*. Smithsonian Institution.

Sanjiangyuan Nature Reserve Monument. 三江源自然保护区纪念碑 C%BA%E7%BA%AA%E5%BF%B5%E7%A2%91/232759 Accessed 26/04/2026

Schäfer, E. (1938). *Dach Der Erde. Durch das Wunderland Ochtibet*. Verlag von Paul Parey.

Stein, R. A. (1961). *Les tribus anciennes des marches sino-tibétaines. Légendes, classifications et histoire*. Presses Universitaires de France.

Stein, R. A. (1972). *The Tibetan Civilization.* (J.E. Stapleton Driver, Trans.). Faber and Faber LTD. (Original work published 1962)

Strang, V. (2023). *Water Beings: From Nature Worship to the Environmental Crisis*. Reaktion Books.

Swyngedouw, E. (2009). The political economy and the political ecology of the hydro-social cycle. *Journal of Contemporary Water Research and Education*, *142*, 56–60. https://doi.org/10.1111/j.1936-704X.2009.00054.x

Tafel, A. (1914). *Meine Tibetreise. Ein Studienfahrt durch das nordwestliche China und durch die Innere Mongolei in das Östliche Tibet*, Zweiter Band (Vol 2). Union Deutsche Verlagsgesellschaft.

Taylor A. R. (1895). *Pioneering in Tibet.* Morgan and Scott.

Teichman, E. (1922). *Travels of a consular officer in Eastern Tibet. Together with a History of the relations between China, Tibet and India*. Cambridge University Press.

Thargyal, R. (2007). *Nomads of Eastern Tibet. Social Organization and Economy of a Pastoral Estate in the Kingdom of Dege.* T. Huber (Ed.) Brill.

Tsomu, Y. (2024). *Chieftains, Lamas and Warriors: A History of Kham 1904–1961*. Lexington Books. https://doi.org/10.5771/9781666959000

Van Gennep, A. (1981). *Les Rites de Passage: Étude Systématique des Rites*. Éditions A. & J. Picard. (Original work published 1909)

Van Slyke, L. P. (1988). *Yangtze: Nature, History, and the River*. Addison-Wesley.

Van Spengen, W. (1995). The Geo-history of long-distance trade in Tibet 1850–1950. *The Tibet Journal*, *20*(2), 18–63.

Van Spengen, W. (2000). *Tibetan Border Worlds: A Geo-historical analysis of Trade and Traders.* Kegan Paul International.

Wellby M. S. (1898). *Through Unknown Tibet*. T. Fisher Unwin Paternoster Square.

Yu, G., Liu, L., Li, Z., Li, Y., Huang, H., Brierley, G., Blue, B., Wang, Z., & Pan, B. (2013). Fluvial diversity in relation to valley setting in the source region of the Yangtze and Yellow rivers. *Journal of Geographical Sciences*, *23*(5), 817–832. https://doi.org/10.1007/s11442-013-1046-2

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.