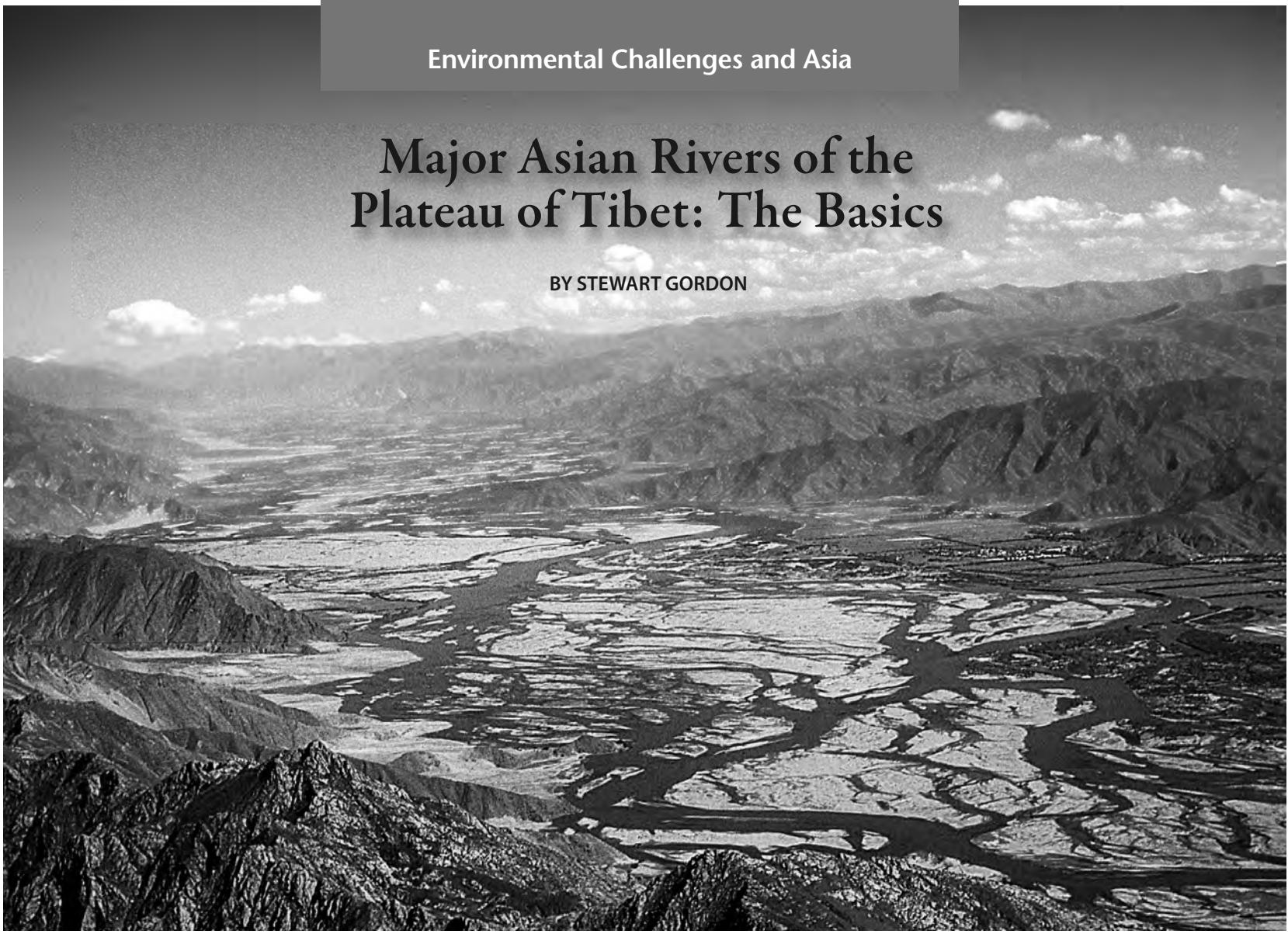
Major Asian Rivers of the Plateau of Tibet: The Basics

BY STEWART GORDON



Brahmaputra River on the Plateau of Tibet. ©2010 Imaginechina.

Physical Geography

In relatively recent geologic times, less than forty million years ago, the Indian subcontinent crashed into the Eurasian tectonic plate. As the South Asian plate began to subduct under the Eurasian plate, it pushed up the Himalayas, the Plateau of Tibet, and folded the ranges of mountains to the east of the Plateau of Tibet. The Indian plate is still converging on the Eurasian plate at a little over three-quarters of an inch per year, deforming the boundary and raising the Himalaya Range. This rate is faster than fingernails grow.

The Plateau of Tibet and its surrounding mountains have rarely been treated as an ecological zone because studies, especially studies of rivers, are usually country-specific.[1] As an ecological zone, the enormous barrier of the Himalayas and their eastern extensions ecologically divide the region into two parts. The southern slopes receive rain on the lower slopes and snow on the tops of the mountains. This rain and snow generate rivers that flow east, south, and west off the mountains. These same Himalayas, however, form an enormous barrier to moisture-laden clouds. North of the Himalayas is a rain-shadow that extends from Tibet through the Takla Makan and Gobi Deserts. Over millennia, the rain shadow has become increasingly drier.

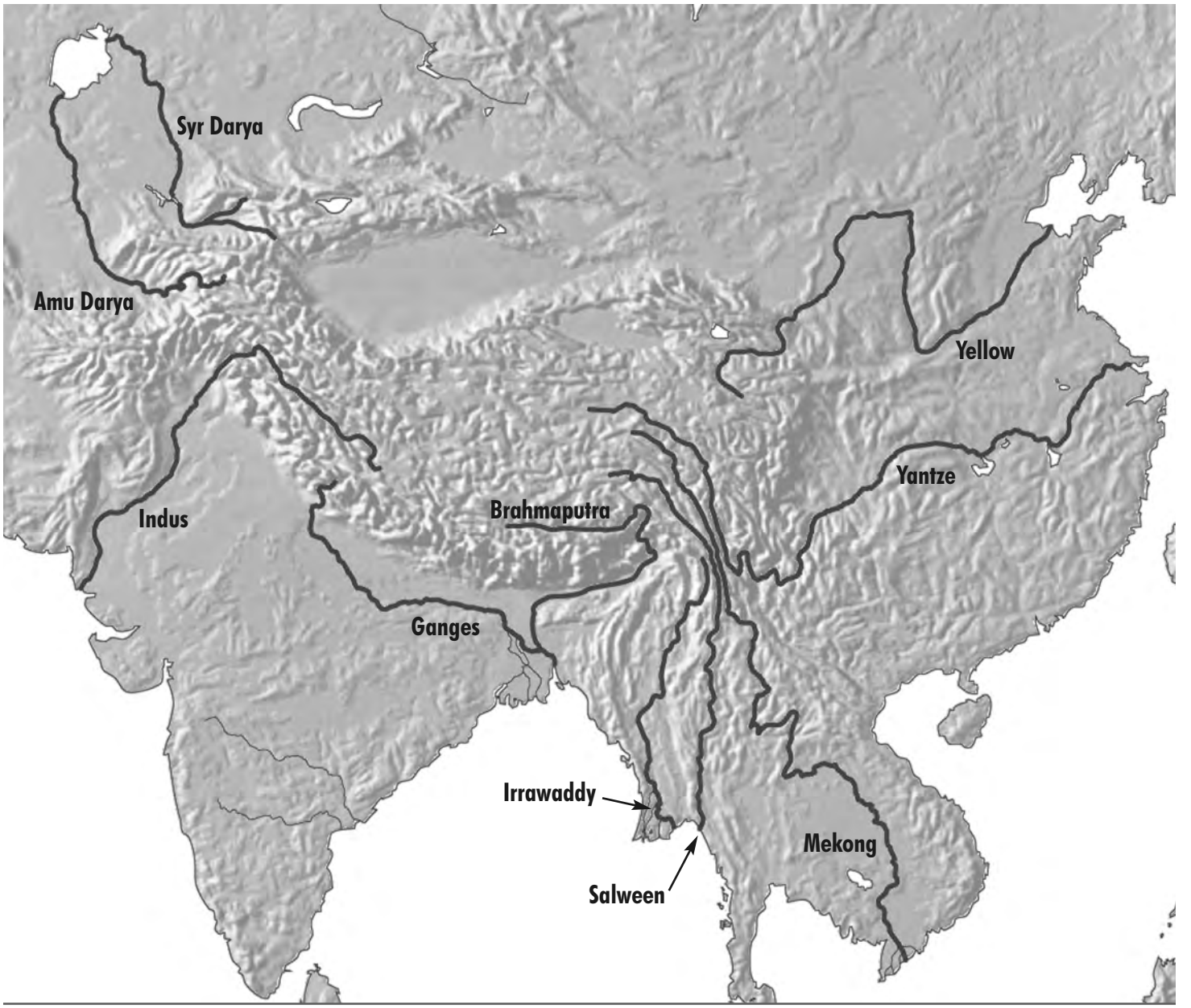
Twelve major rivers originate on this uplifted plateau. They provide fresh water for somewhat less than half of the current human population. Starting in China and moving in a clockwise direction around Asia, these rivers include the Yellow, Yangtze, Red, Mekong, Salween, Irrawaddy, Brahmaputra, Ganges, Helmand, Amu Darya, and Sir Darya. Ten are more than 1,000 miles long.

Yangtze–3,965 miles
Yellow–3,395 miles
Mekong–2,750 miles
Indus–1,975 miles
Syr Darya–1,913 miles
Salween–1,901 miles
Brahmaputra–1,765 miles
Amu Darya–1,630 miles
Ganges–1,560 miles
Irrawaddy–1,335 miles

Several include the largest drainage basins on earth.

Ganges and Brahmaputra–668,000 square miles
Yangtze–454,000 square miles
Yellow–378,000 square miles
Indus–371,000 square miles
Mekong–313,000 square miles[2]

The essential ecology of these rivers is governed by the yearly rhythm of monsoon rains. The prevailing offshore winds from January through May generally bring dry weather.[3] Onshore winds in June through October bring moisture-laden clouds and rain. This pattern is pronounced across the whole of the southern perimeter of mainland Asia—from the west coast of India (around Myanmar), Malaysia, Việt Nam, and coastal



Map created by Willa Davis using *Mountain High Maps* Continental Edition, ©1995 Digital Wisdom.

China, to Korea. Monsoon rains fall first on the lower reaches of the rivers, then the rain moves inland and up towards the plateau. As the moisture-laden air rises, moisture first falls on the foothills and then on each successive range, either as rain or snow.

The monsoon effect lessens sharply for the rivers that start on the west of the Plateau of Tibet. There is simply little remaining monsoon moisture by the time the clouds have dropped rain across the Indian subcontinent. Once out of the mountain snowpack, the Syr Darya and Amu Darya receive little additional water; the downstream area receives less than four inches of water a year. The Indus gets some additional water from the foothills of the Himalayas, which receive about eight inches of rain during monsoon, but further downstream the Pakistan plain is essentially dry, receiving only about four inches of rain per year.

Moving east, the Ganges River receives substantial downstream water during the wet monsoon, while the lower Ganges plain receives as much as eighty inches of rain per year. The middle and lower reaches of the Brahmaputra receive more than 200 inches of rain during the wet monsoon, and the flow of the river increases almost five times.[4] The rivers of mainland Southeast Asia and China receive sixty to eighty inches of downstream rain, which adds significantly to the flow of these rivers. The concentration of rainfall in the June through October period makes for serious problems, flooding during the wet monsoon and low water the rest of the year. (The western rivers, with little rain contribution, have a more consistent flow.) The Yangtze, the Yellow, and the Brahmaputra are typical of the nine eastern rivers and traditionally have had low water seasons that exposed rocks in the riverbed followed by floods or near-floods.

All of these rivers carry silt, mainly picked up in the middle reaches of the river, often from side streams, when the water is moving relatively fast. The silt is then deposited in the lower river basin; fifty percent of the silt makes it to the sea to form deltas. As a whole, the rivers that come off the Plateau of Tibet carry great quantities of silt. About seventy percent of all silt carried to the ocean by rivers comes down Asian rivers.[5] The heaviest silt load on earth is carried by the Yellow River. For millions of years it has gathered silt while cutting through a broad plain of fine-grained loess soil. The river deposits much of this silt in the last slow-moving 435 miles of the river, which drops a little over two feet per mile.

Cultural Geography

The broad arc from Bengal around mainland Southeast Asia and the south plains of China has been the heartland of rice for millennia. Rice demands regular irrigation, and the more water control, the higher the yield.[6] The human interventions for rice are terracing and field inundation, using irrigation water from rivers. Many of the most successful and sophisticated empires of Asia have been based on the caloric yield of intensive rice cultivation. These include Angkor in Cambodia, Ayuthia in Thailand, many Chinese dynasties, and the Gupta Empire in India. In the last century, irrigation from the Himalayan Plateau rivers has vastly expanded. Along the Yellow River, irrigated land is twenty times what it was at the end of World War II. There have been major irrigation developments in the deltas of the Ganges, Mekong, Yangtze, Irrawaddy, and Brahmaputra. These areas have become some of the highest human density areas in the world.[7]

There have long been pronounced ethnic differences on different sections of these rivers. Mountain economies in the headwaters center on migratory herding or gathering. The people spoke (and often still speak) a different language than people who live on other sections of the river. The livelihoods of those living in the middle sections are often a mix of herding and agriculture, including terrace farming. These people usually cut trees for firewood and to open new land for agriculture. Large-scale deforestation is typical of the middle reaches of several of these rivers, and deforestation has been especially noted on the Brahmaputra, Ganges, and both the Yangtze and Yellow. The people of the middle reaches often speak a different language from those who live on the plains near the lower reaches of the river.

The Tibet Plateau-originated rivers of Asia have complex cultural meanings for the various ethnic groups along their lengths. In India, for example, the story of the descent of the Ganges from the celestial realm to earth is widely told and portrayed in Hindu sculpture. Many ethnic groups who live along these rivers have considered them sacred for centuries, if not millennia. Throughout the centuries, holy men and lay people alike have bathed in the Ganges. In China, people who live along the lower Yangtze have ceremonies to propitiate the dragon that is the Yangtze River.

"Control" of several of these rivers—the Yellow, the Yangtze, the Mekong, and the Irawaddy—has required enormous human effort for hundreds or thousands of years. On the plains of China, for example, the natural process is for the riverbed gradually to rise as silt settles to the bottom during the river's slow flow through the plains. To keep the river from flooding the surrounding agricultural fields requires constant maintenance of dikes, creation of channels to increase flow, cleaning the bed to increase depth, and impounding water into lakes and swamps. On the Yellow River, there have been 1,750 disastrous floods caused by breaks in the river dikes between 650 BCE and 1950 CE.[8] The current Chinese government has built many small dams upstream and has managed to cut the deposit of silt by the Yellow River by about half, but the current riverbed on the lower river still stands nearly ten feet above the surrounding plain.

From earliest times, several of these rivers had, and still have, competing water requirements. Water for cities competes with water for agriculture. Transportation on the river requires high water, which competes with tapping off water for irrigation. In China, for example, the government needed high water to cross the Yangtze and Yellow Rivers to transport rice from the south to the food-poor north. The peasants needed to tap off water for irrigation and prized the nutrients of river silt. Five of the twelve rivers pass through more than one country. The Mekong begins in western China, forms the Cambodia-Thailand border, and crosses Laos and Việt Nam. National priorities often compete and conflict. Irrigation in the Fargana Valley of Kirgistan lessens flow of the Sir Darya to Kazakhstan and the Aral Sea.[9] Within China, recent irrigation projects to supply water to the capitals of the states of Ningxia and Inner Mongolia have decreased flow to the lower Yellow River.[10]

Many countries have built dams on the upper reaches of these rivers as a solution to yearly periodic rains, occasional drought, and to produce hydroelectric power. Several of these dams have provoked serious political opposition, especially by upriver ethnic groups who see only displacement and destruction of their livelihood and no attendant benefit from either hydroelectric power or water storage. As dams have been built and experience with them grows, problems have emerged.[11] Silt fills up the catchment area behind the dam and renders it much less useful for both electricity and water storage. The hydroelectric power is generated at mountain sites far from the demand areas that are usually cities on the plains or on the coasts.

Construction of the Jinhong hydropower plant on Lancang River (part of the Mekong River in Yunnan Province, China).

Conclusions

In what ways, then, is it useful to treat the rivers of the Plateau of Tibet as a single unit for teaching? First, this perspective changes our focus away from national boundaries or even civilizations ("China," "India") to large catchment, watershed, and flow areas that sprawl across political borders, ecological zones, ethnic regions, and language boundaries. This sort of analysis shows the intimate dependencies of all those whose lives or livelihoods depend on the waters of the rivers. Second, focus on this group of rivers allows geographical and institutional comparisons among ways the waters have been used for the development of complex civilizations. From this perspective, it becomes germane to compare Indus with Angkor. Third, there is a common set of problems for managing these rivers—silting, low water, high water that results from monsoonal rains, the watershed, the lower-river belonging to different political entities, and the competing demands of irrigation, industry, and cities. Finally, all of these rivers are seriously threatened by global warming with its consequent decrease in the glaciers and snow pack that feed the rivers that begin on the Plateau of Tibet.

Teaching and Bibliographical Notes

There are exploratory accounts of every one of these rivers, usually produced by an early colonial mapping or military expedition. In our own time, since these rivers are critically important to the economies of all states they cross, there are literally thousands of scientific articles and reports on their

flow, silt accumulation, flora along the banks, fauna, and policy considerations of dams, irrigation, and water usage. There are hundreds of legal articles on treaties between Asian nations that share rivers.

For introductory teaching about the commonality of Asia's large rivers, there is nothing better than *Google Earth*. Students can trace rivers and see the terrain they pass through and influence. Many places along the way will have embedded photos of specific sites. Particularly striking is the first appearance of terraced fields that can be compared among several rivers. Dams and their lakes are obvious. Irrigation also shows up. Deforestation is clear in these photos, as is road access.

Contrast the unified "Plateau of Tibet" approach of this article to Asia's rivers to the approach in *Asia for Educators* from Columbia University (http://afe.easia.columbia.edu/geography/element_b/eb5.html) and the Annenberg project on geographical teaching (http://www.learner.org/resources/series180.html), both of which accept national boundaries in the demarcation of geographic regions.

Many of these rivers have also generated popular books, often lushly illustrated. For example, see John Hoskin, *The Mekong: A River and Its People* (Bangkok: Post Publishing Co., Ltd., 1992).

Historians with an ecological bent have occasionally treated a whole river but more frequently a portion of the river or an ethnic group that lives along it. Typical are the collected papers in Constance M. Wilson (ed.), *The Middle Mekong River Basin: Studies in Tai History and Culture* (DeKalb, IL: Center for Southeast Asian Studies, Northern Illinois University, 2009).

These rivers have also fascinated non-scientific writers who have written a host of books that discuss the ways the river provides structure to societies. Recall Eric Newby's comedic *Slowly Down the Ganges* (1966). The Yangtze, for example, has inspired literature for centuries, short pieces of which are anthologized in Madeleine Lynn, *Yangtze River: The Wildest, Wickedest River on Earth* (Oxford University Press: Hong Kong, 1997). ■

NOTES

1. This is one of the few articles to treat transnational aspects of rivers over a broad swath of the Himalayas and Plateau of Tibet. It does not, however, include the rivers of China. Jayanta Bandyopadhyay and Dipak Gyawali, "Himalayan Water Resources: Ecological and Political Aspects of Management", *Mountain Research and Development* 14, no.1 (February 1994): 1–24.
2. All of the essentials of the rivers that originate on the Plateau of Tibet are taken from *The Times Atlas of the World* (London: John Bartholomew & Sons Ltd. Seventh edition, 1988), x1v, xv. A lovely large map of Asia that shows all of the rivers is found on xxxvi and xxxvii.
3. The monsoon is a seasonal reversal of winds caused by the difference in atmospheric pressure from the differential heating of land and ocean. In winter, high-pressure cells develop over continental Asia producing sinking air that results in an offshore monsoon. The winter monsoon produces little precipitation. In summer, the heating of the Asian continent results in rising air and, therefore, lower pressure. The moist maritime onshore winds bring extensive precipitation to certain areas during summer.
4. Bandyopadhyay and Gyawali, 3.
5. See John H. Millmanand and Robert H. Meade, "Worldwide Delivery of River Sediments to the Ocean," *Journal of Geology*, 91, no.1 (February 1983): 1–21.
6. Te-Tzu Chang and A. H. Bunting, "The Rice Cultures," *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 275, no. 936, *The Early History of Agriculture* (July 27, 1976): 143–157.
7. Using irrigation from the Indus, the Punjab has become one of India's largest food producing areas based on high-yield wheat.
8. Mei Chengrui and Harold E. Dregne, "Review Article: Silt and the Future Development of China's Yellow River," *The Geographical Journal*, 167, no. 1 (March 2001): 15.
9. Fergana, which is watered by the Amu Darya, has been fought over for centuries. See, for example, a description of it in the memoirs of Babur, a descendant of Ghengis Khan who inherited the valley and lost it to Uzbegs in the 1490s CE. Babur, *Babur-Nama* (*Memoirs of Babur*), trans. Annette Sussanah Beveridge (New Delhi: Low Price Publications, 1989, reprinted edition), 1–12.
10. Mei Chengrui and Harold E. Dregne, 10.
11. Zeb Hogan, "Tonle Sap: The Flowing Heart of Cambodia," *NPR*, December 6, 2005, http://www.npr.org/templates/story/story.php?storyId=5039980; "China Rejects Mekong River Dam Criticism," *BBC News*, April 5, 2010, http://news.bbc.co.uk/2/hi/8603112.stm; Nirmal Ghosh, "Mekong River Talks: Dams Be Damned," from Asia News Network, *The Straits Times*, April 4, 2010, http://www.asianewsnet.net/climate/detail.php?id=109&sec=11.

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