# THE YELLOW RIVER

## sustainability as dialectic

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James E. Nickum and Jia Shaofeng

# Among the SERIDAS rivers

## Most similar to the Nile

- Length 5400 km (cf 6650 km)
- Modest discharge, concentrated in the summer
- Historical importance as a silt conveyor
- Area under irrigation similar

## Most similar to the São Francisco

- Basin area 752,000 sq km (cf 630,000 sq km)
- In one country

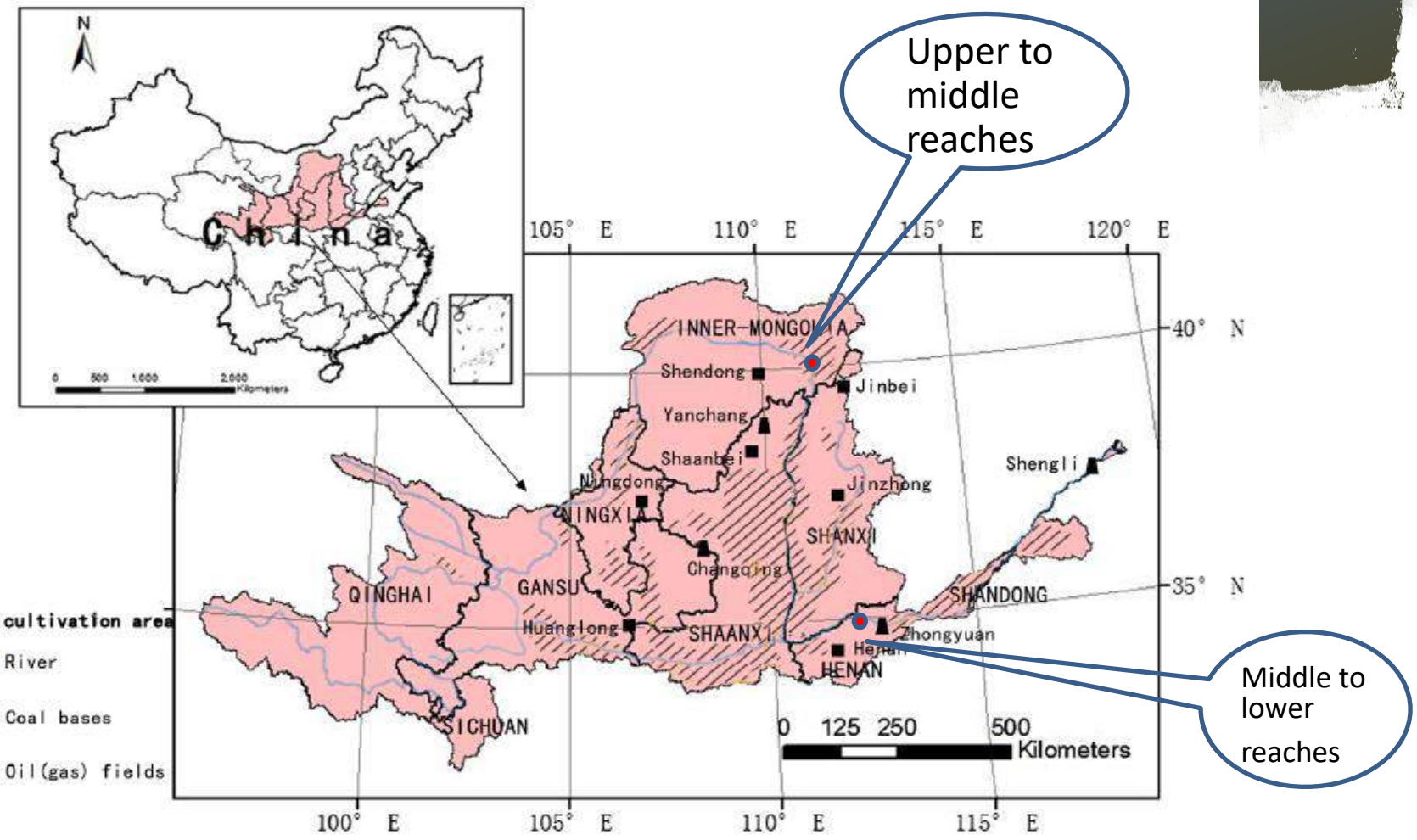
# Sustainability as dialectic

- **"Solving" one problem through engineering leads to another**
  - Flood control by diking leads to increased catastrophic flood risk in a silt-laden river
  - Withdrawals for human use upstream endanger supply downstream in a highly seasonal, oversubscribed river
  - Without silt as well as water, the delta recedes
  - Mainstem reservoirs can affect river regime, but can be operated to address sustainability concerns
  - Conventional engineering is of limited use in erosion control

# The three reaches of the Yellow River

| Reach | Mainstem length (km) | Catchment area ($km^2$) | Runoff contribution | Silt contribution | Drop in elevation (m) | Slope | Population (M) | Major tributaries |
|---|---|---|---|---|---|---|---|---|
| Upper | 3400 | 386,000 | 53% | 9% | 3464 | 0.10% | 30 | 43 |
| Middle | 1200 | 344,000 | 37% | 89% | 880 | 0.07% | 80 | 30 |
| Lower | 786 | 22,000 | 10% | 2% | 95 | 0.01% | 13 +55 | 3 |

# Locating the Yellow and its reaches



# Large reservoirs on the upper reaches

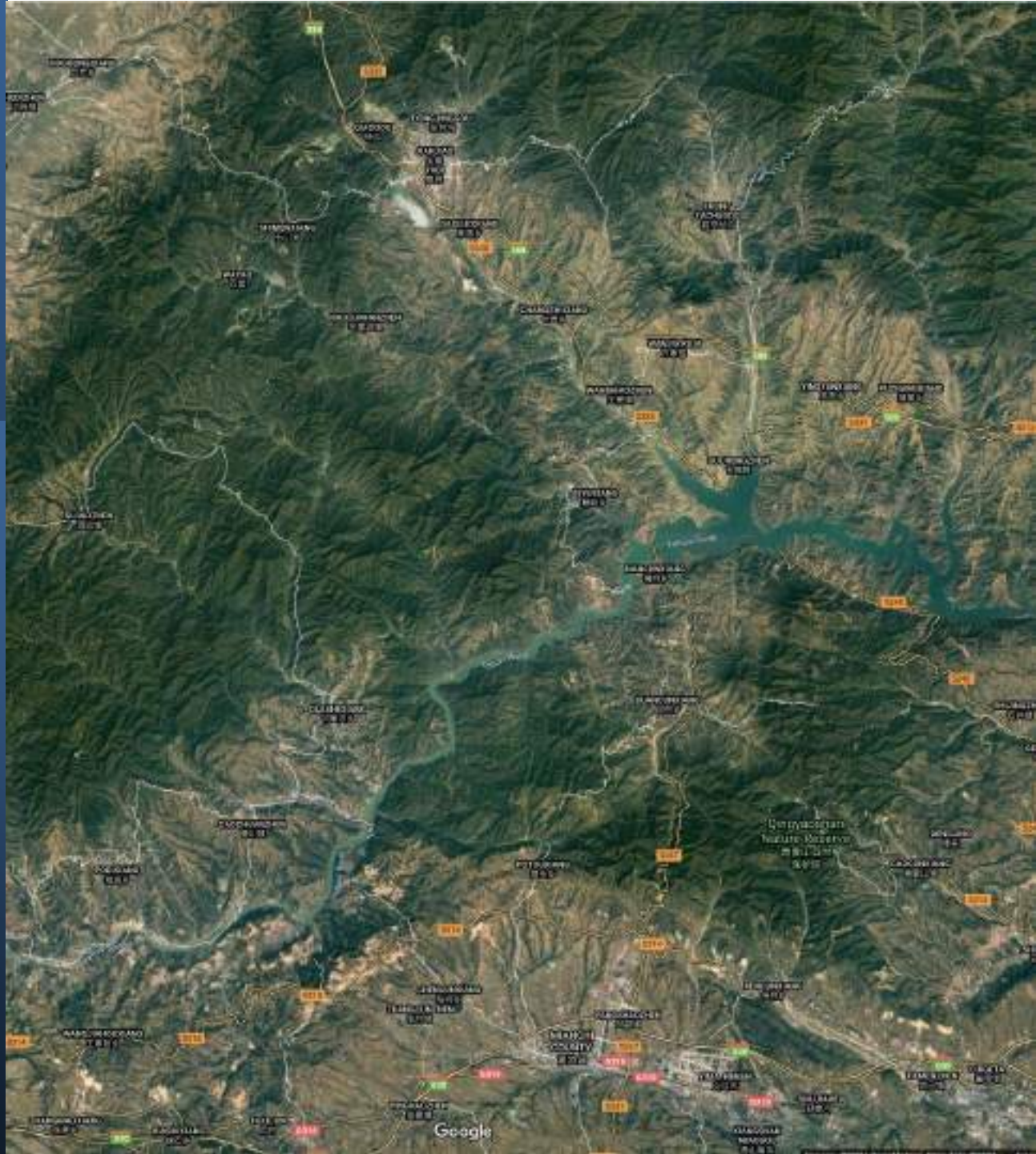
## hydropower, flow regulation

# The large irrigation areas in the semi-arid upper reaches

# The middle reaches

# The loess plateau (closeup)

# The large downstream reservoirs



# Downstream, part 1

To do list

1. Flood control

- **Yu the Great, the legendary first Engineer of the Yellow River**
  - **ca 4300 years ago**

Wide dikes at Huayuankou

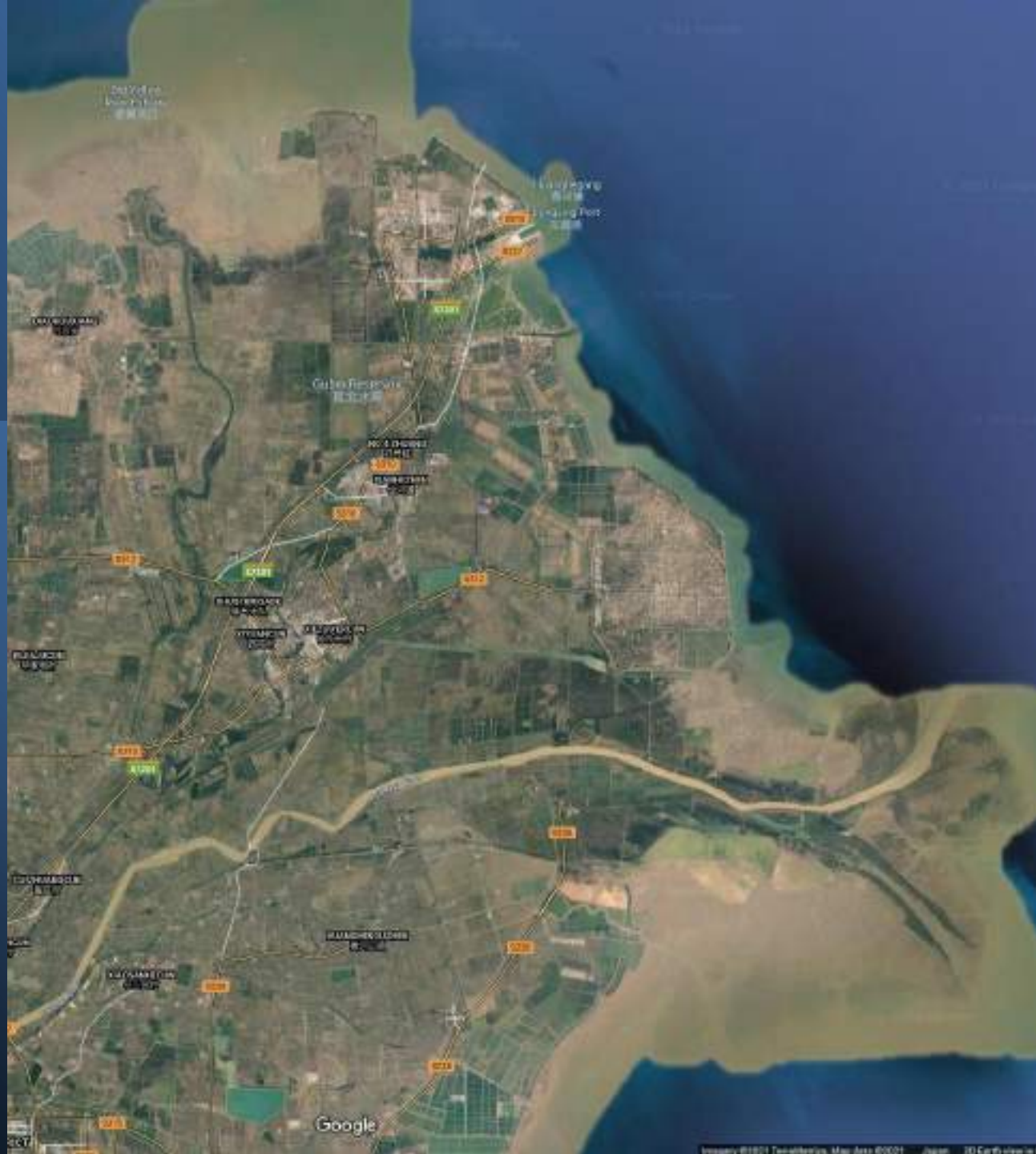
Photo by J. Nickum, 1974

**modern engineer of the Yellow River**
photo by J. Nickum, 1974

# Across the North China Plain

## as the watershed

# The present delta

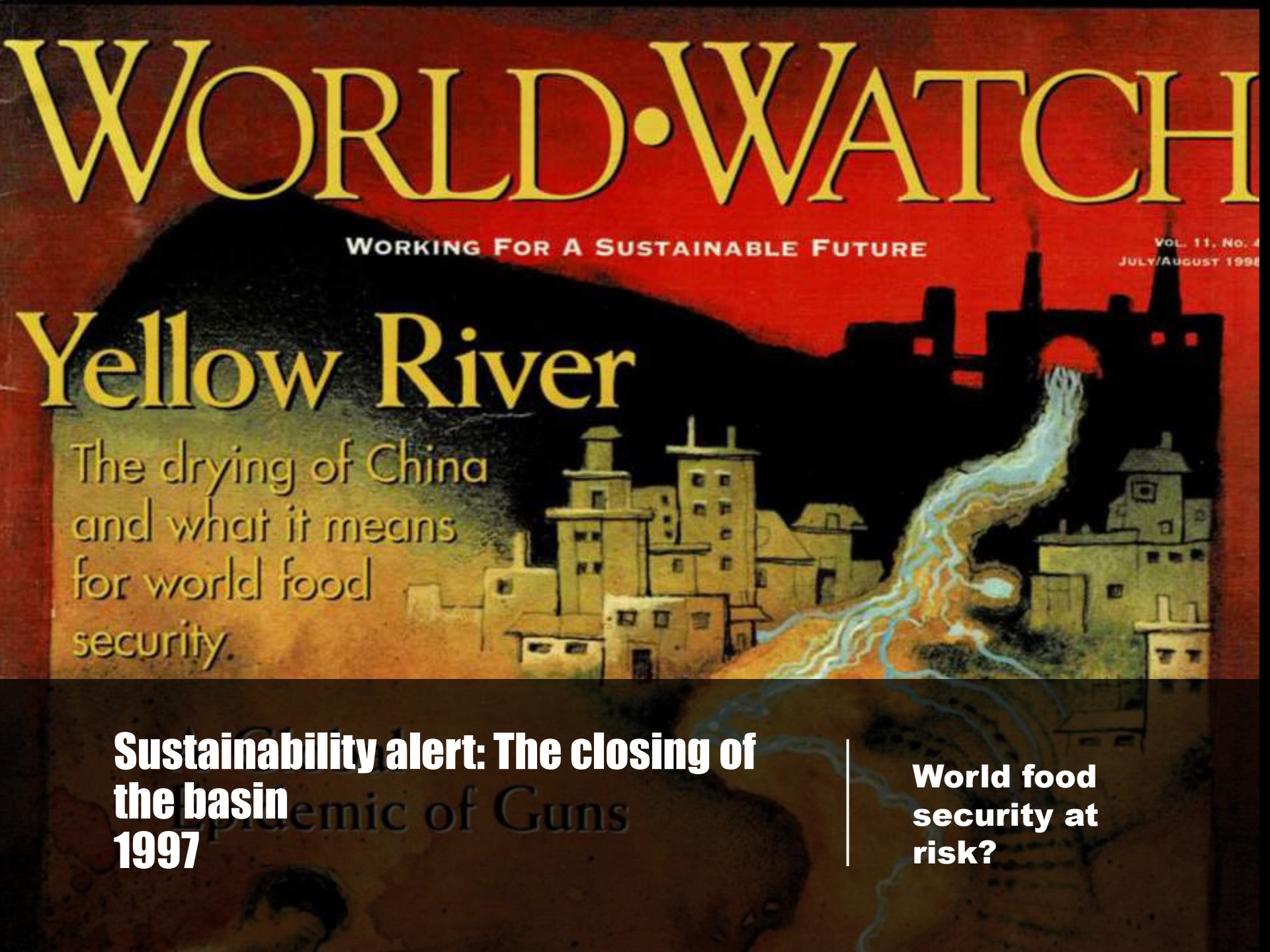


# 1997

With ENSO droughts and increasing withdrawals after 1972, the Yellow River often did not reach the sea in winter

In 1997, it reached the sea for only 35 days.

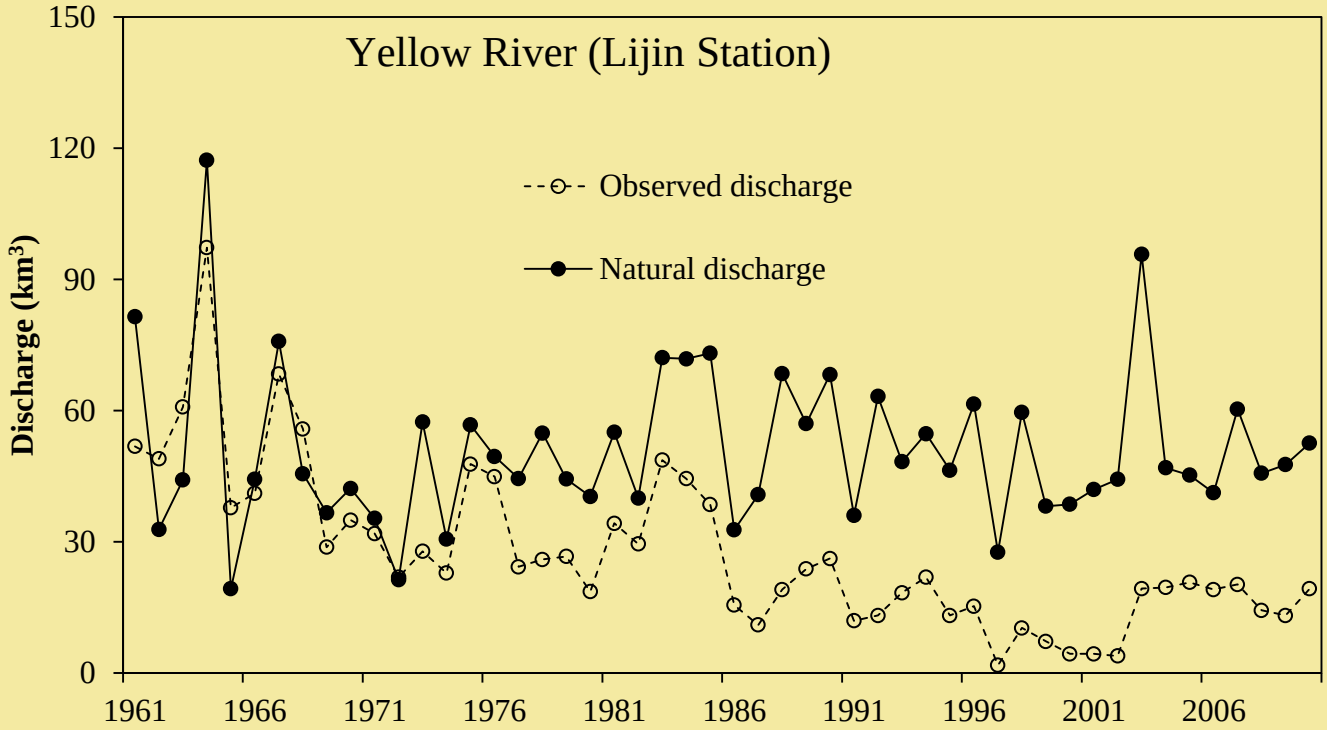
At one point in time, it ran dry 703 km from the sea.


WORLD·WATCH
WORKING FOR A SUSTAINABLE FUTURE
VOL. 11, NO. 4
JULY/AUGUST 1998
Yellow River
The drying of China and what it means for world food security.
Sustainability alert: The closing of the basin 1997
World food security at risk?

# Reopening the Yellow River, 1997-date

- Adjusted interprovincial quota system that had been set in wet years.
- Ensuring minimum flow at the estuary made an overriding objective of river engineers
- Digital Yellow River real-time monitoring and control
- Completion of second largest reservoir behind Xiaolangdi to regulate silt, flood and minimum flow
- The river now flows to the sea, although often not enough to cover environmental flow quota

# Observed compared to natural discharge at the Yellow River estuary, 1961-2010



# Natural runoff and silt load over time

| years | Mean natural runoff ($km^3/y$) (Huayuankou) | Mean silt load ($10^9$ t/y) (Tongguan) |
|---|---|---|
| 1919-1975 | 55.9 | 1.63 |
| 2000-2015 | 45.2 | 0.274 |

- Natural runoff = observed runoff + consumptive uses of surface water (地表耗水还原量) +change in reservoir storage

# Where did the runoff and silt go in the 21st century?

- It stayed in the loess plateau
  - Impoundments (check dams) of limited effect – most are silted up
  - More terracing of fields, but most of all
  - Trees and grass
  - Other possible factors: groundwater abstraction
- Is this for good? Is the dilemma solved?
  - Some engineers say no, floods could restore silt load
  - Jia says yes, vegetative cover can be expanded considerably as people move out of marginal areas

# We left out most of the story of the Yellow River's sustainability dialectics

- If you want to know what we left out
- Read the chapter!
- Thank you very much!