Environment Flow: Research and Actions in the Yellow River

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Poor water but big population
Rich sediment, leads to heavy deposition and flood crisis

Total length 5464km.
Population 156 million.
Average annual runoff 53.5 b m³.
Annual sediment load 1.6 billion t.

Drainage area 795,000km².
Average annual precipitation 452mm
Groundwater 11 b m³
Sediment concentration 35kg/m³.
▲ Problems in history: frequent and heavy flood disasters
muddy water unsuitable for irrigation

▲ Strategy in history:

---- to fight, control and even abolish the flood
---- to utilize the water as more as possible

  by all the possible means.

► Achievements:

--no dyke breaching any more
--more than 60~80% water used

………

But………
**Present situation:**

Excessive flood control and excessive water use have made the river’s natural function degraded significantly:

---main-channel shrunk  
---drying-up  
---worsening water quality  
---wetland decline  
---valuable fishes disappeared……..

Thus have greatly restricted the economy sustainable development and threaten the human health.

*Keep a Healthy Life of the Yellow River  Leave Environmental Flow for Yellow River.*
How to Understand the EF?

• EF = water demand of river ecosystem?

• What is the original reason for putting forward concept of environment flow?
  ---- to set up a threshold for the increasing human water consumption, so that the river’s natural function could be protected properly at an acceptable level.

**EF:** the flow for keeping the river an acceptable natural function.
The contents of Yellow River’s EF

- **Water for river ecosystem**, mainly refer to fishes and wetlands along the River.
- **Water for self-purification**.
- **Water for transporting water and sediment**.
  Since the sediment and water mainly is transported by the main-channel, water for transporting water and sediment should means the water for main-channel configuration modeling and maintaining.
- **Water for landscape** ……
How to calculate the YR’EF?

Step one: The target of environment protection?

- It is not always easy to identify the environment protection target since the increasing population. In past 56 years, the population in China has increased by 2 times!
- So it should be a kind of balance or compromise between human being and others to decide the environment protection target, especially in Yellow River which only possesses 53.5 billion m³ of runoff but 1.56 billion populations. ……
- The target of environment protection is **not only a scientific choice, but a social choice.**

The initial results:

- delta wetland and aquatic ecosystem: later 1980s
- water quality: III degree generally
- bank-full discharge of the main-channel: larger than 4000 m³/s.

Still: **not enough stakeholders involvement.**

**not enough environment evaluation (wetlands and fishes)**
How to calculate the YR’EF?

Step two: to identify the relation between the protected objectives and river’s runoff.

Step three:

acceptable target + scientific relation

• Water for sediment transporting
• Water for self-purify
• Water for river ecosystem
• Water for landscape…..

Integrated: 22.5 bm³

Need more research since lack of enough observation and analysis
How to calculate the YR’EF?

**Step four: to balance**

- **EF**: 22.5 b m$^3$
- Human water demand: 41 b m$^3$
- Total runoff: 53.5 b m$^3$

YR can’t afford human and environment both at their desired runoff scale!

What’s the right way?

- to reduce the water requirement of both two side

**Healthy rivers:** human’s benefit and other organism’s benefit could be harmonized in corresponding period and river reaches, or its social function and ecological function could be balanced.

- 18.4 bm$^3$ for river’EF, 2 bm$^3$ for soil erosion fighting, 33.3 bm$^3$ for people
How to calculate the YR’EF?

Attention:

• Average year: EF 18.4 bm³
• How about dry year? Reduce both further.
• Principle: the runoff must be larger than the minimum EF at any time.

• Minimum EF:
  --water for lowest ecosystem scale
  --drinking water for people
More attention and support to Yellow River EF is welcome
The local actions to realize the EF

- **Pilot Action one:**
  regulate the whole river’s runoff by controlling people’s water consumption from 1999, which was forced by serious drying-up situation from 1972.

- **Pilot Action two:**
  regulate the runoff in flood reason for producing the proper flood which is very important for main-channel modeling and maintaining.
The local actions to realize the EF

- United Water Distribution Program in whole YR has been lasting for more than 6 years..
- 4 artificial floods (named as Flood and Sediment Regulation Program) has been made since 2002. ..... 
- **Going very difficultly at beginning period.**
- **Achievements present:**
  - no drying-up happen again.
  - delta wetland shrinkage stop and even increased by 20%
  - some valuable fishes appear again
  - bank-full discharge increased from 2000 to 3500 m$^3$/s

▲ Still can’t satisfy with the desired EF.
▲ There is still a long way to go!