In-stream water use – how much value does it carry?

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Introduction

- Rivers from SOURCE to SEA
- $\text{H}_2\text{O} \rightarrow$ from HILL to OCEAN
In its journey, river water gives humanity several benefits
- contributing to economic growth;
- determining ecosystem pattern.

River basins are cradles of civilization.

Several offstream and instream uses.

In developing countries, poor riparian people are strongly tied with river flow for their life.
Introduction

- In-stream flow provides several goods and services → important economic spin-off.

- In-stream flow protection normally
  - imposes large opportunity costs &
  - results conflicts with offstream demands.

Therefore, valuation of in-stream uses will help guiding in overall basin management.
Some earlier works are found valuing the in-stream flow (Loomis 1998; Douglas & Taylor, 1998; Xu et al., 2003; Ojeda et al., 2008)

however, valuation based on marginal benefits from in-stream water use is rarely estimated & no study done for any river in Bangladesh.

This study aims to estimate the total and marginal benefit function of in-stream water direct uses for Teesta River from Bangladesh.
Study site

- Study area of Teesta river, Bangladesh

- One irrigation barrage serves 11,732 ha
- Socio-economically very poor region
- Main occupation agriculture, number of people depends on fishery
In-stream water uses

- Only the direct uses are considered
- **River fishery** and small scale navigation are the in-stream water uses in the Teesta.

Fisheries are very important for Bangladesh.

- 5.24% of the country’s GDP & livelihood to 10% population;
- In 2008, size of the capture fishery was 1.060 million mt & culture fishery was 1.005 million mt.

Inland water transport accounts for about 15% of total transport-GDP for the country.
• Needs a link between hydrology and ecology.
• However, such a link is poorly defined & still a daunting challenge due to lack of information (Young et al., 2000; IWMI, 2005, Kashaigili et al., 2005; Arthington et al., 2006).
• A flow-catch model is developed with yearly mean flow and catch.
• Yearly fish production is taken as a surrogate of the fishing effort to analyse the year-to-year trend (Baran et al, 2001) instead of considering CPUE.
Valuation of fishery

- Substituting fish price for the fish catch
- Flow-catch model $\rightarrow$ total benefit (TB) function.
- Differentiating TB function w.r.t. flow gives the MB of water used for fishery.
- Used last 12 yrs catch and flow data
Value of fishery

Intercept is considered from a PHABSIM study

Avg Value of fishery  417,380 USD/yr

\[ TB = -0.0009 \cdot \text{flow}^2 + 1.3495 \cdot \text{flow} - 63.527 \quad (r^2 = 0.7214) \]

MB function, \( \frac{d(TB)}{d(\text{flow})} = -0.0018 \cdot \text{flow} + 1.3495 \)
By primary survey on boatmen

Value of water for navigational use = gross benefits – operating costs

Gross benefit is considered equal of boatmen daily income

Operating cost is negligible and considered as zero because boats are mostly manually operated
Valuation of navigation

• Focus question in primary survey → daily income level at different flow level.

• Established a relationship between income variation for the boatmen and flow variation → total benefit function.

⇒ Differentiating total benefit function gives the marginal benefit
Daily income varies widely with flow level

Average value of navigation 62,805 USD/yr

\[
TB = 0.0017*flow^2 + 8.1166*flow + 458.32 \quad (r^2 = 0.9422)
\]

\[
MB = -0.0034*flow + 8.1166
\]
Discussion

• Fish production depends on natural flow regime but our fish-catch model based on avg yr. flow.

• Currently we are looking fish catch & fishermen income variation in different seasons using primary survey.

Water quality has not been considered in valuation.
Conclusion

- Dry season irr demand is high and water is diverted without proper consideration of instream need.

- Farmers pay for water & Irrigation dept. earned about 56,000 USD in 2005 – 06 FY.

- On the other hand the total in-stream water use benefit is about 480,185 USD (fishery + navigation).

- Instream benefit is >8X higher.
• Need to rethink on dry season flow diversion as fishery is sensitive to dry season flow.

• Results from this analysis will help water manager in allocating the minimum in-stream flow
  – and subsequently will support
    → the river and ecosystem,
    → the riparian poor’s livelihood with overall socio-economic development.
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Thank you for your attention