Improved environmental flows for river restoration – a case study from the Lesser Caucasus, Azerbaijan

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[1] Baku State University, Faculty of Geography
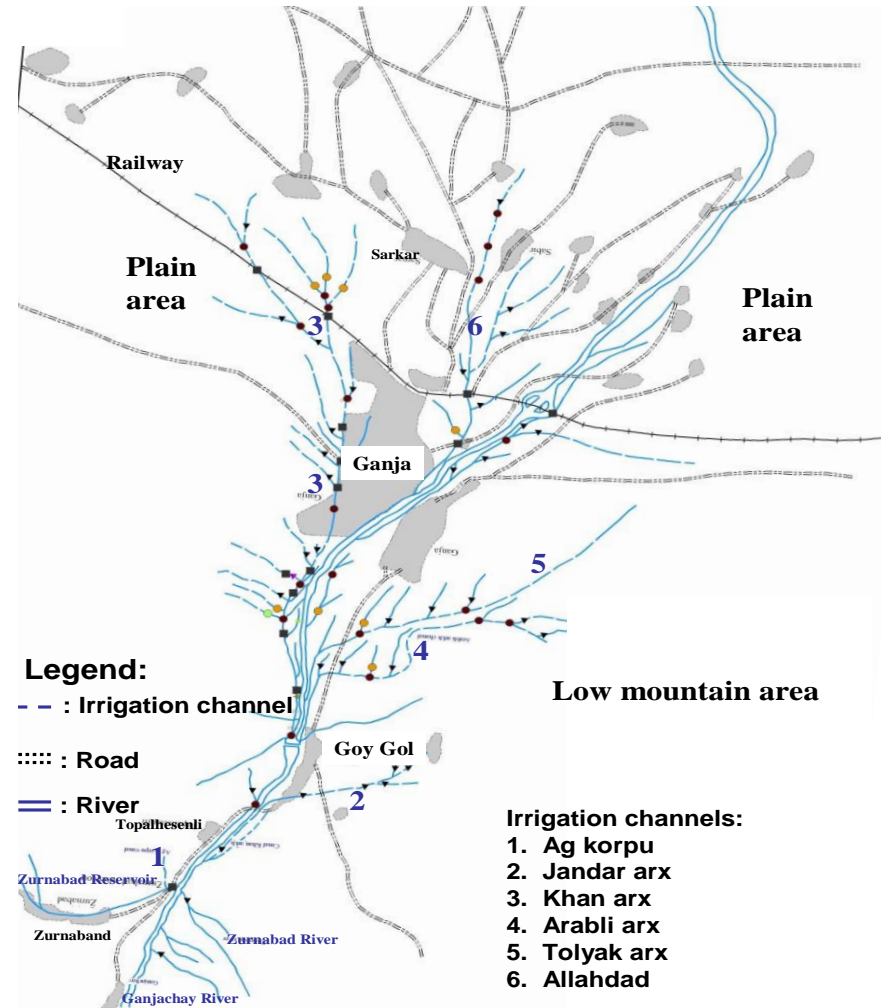[2] UNDP/GEF "Reduction of transboundary degradation in the Kura Aras river basin"

Pilot river basins

Pressure: water abstraction

**Water intake facility
of Zurnabad HPP
Gancachay river**

Railway

Plain area

Plain area

Sarkar

3

6

Ganja

3

5

4

Low mountain area

Legend:
- – : Irrigation channel

::::: : Road

== : River

Goy Gol

2

Topalhesenli

1

Zurnabad Reservoir

Zurnaband

Zurnabad River

Ganjachay River

Irrigation channels:
1. Ag korpu
2. Jandar arx
3. Khan arx
4. Arabli arx
5. Tolyak arx
6. Allahdad

**Irrigation network,
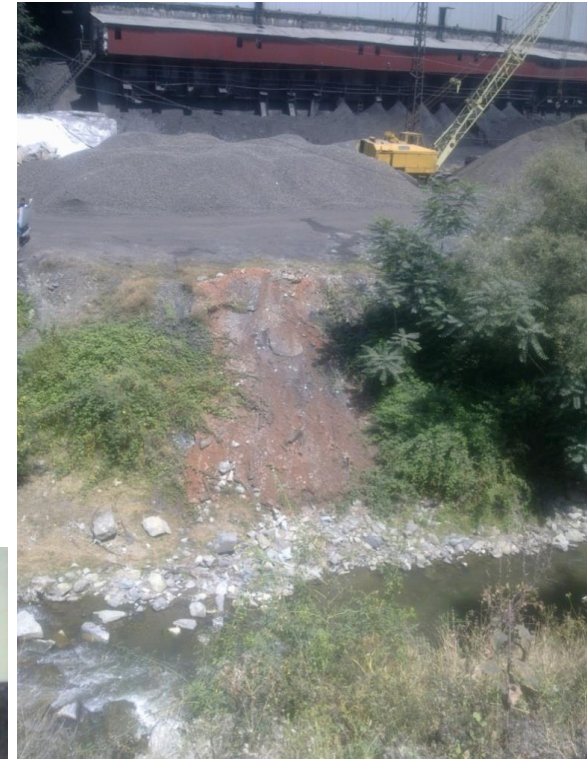Gancachay river basin**

Pressure: industry & mining

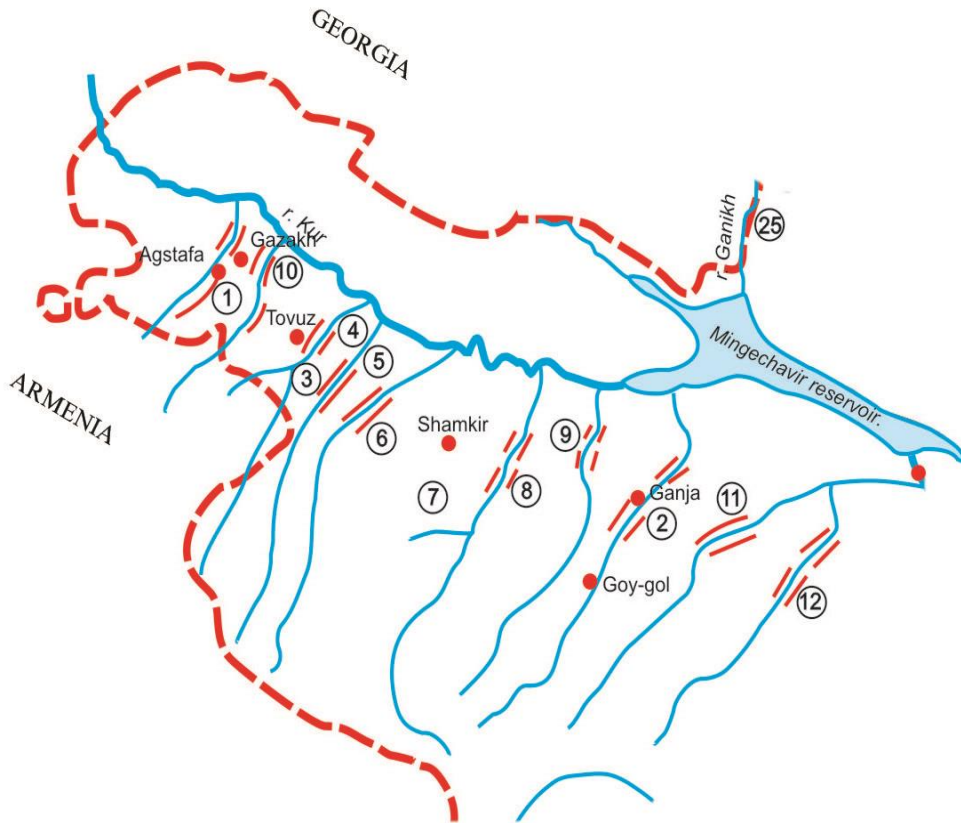*Diffuse & point sources of pollution*

Industrial waste

**Tailing dam
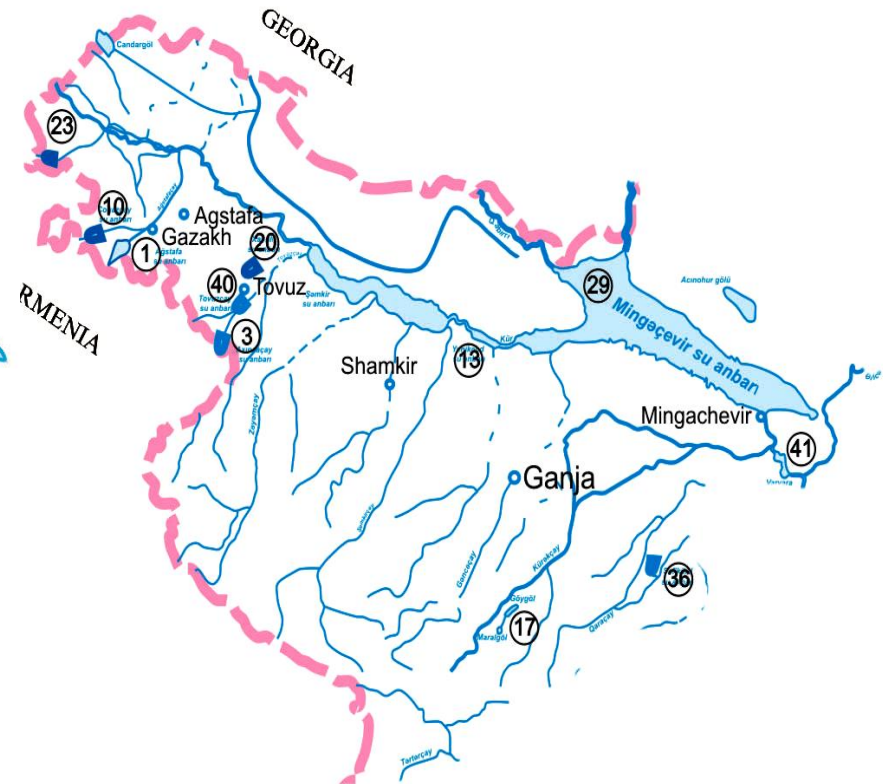Goshkarchay River**

**Iron ore mining
Qoshkarchay River**

Flood protection

Physical and morphological changes of water bodies

Reservoirs with volume > 2 million m³

Flood protection constructions on river bank
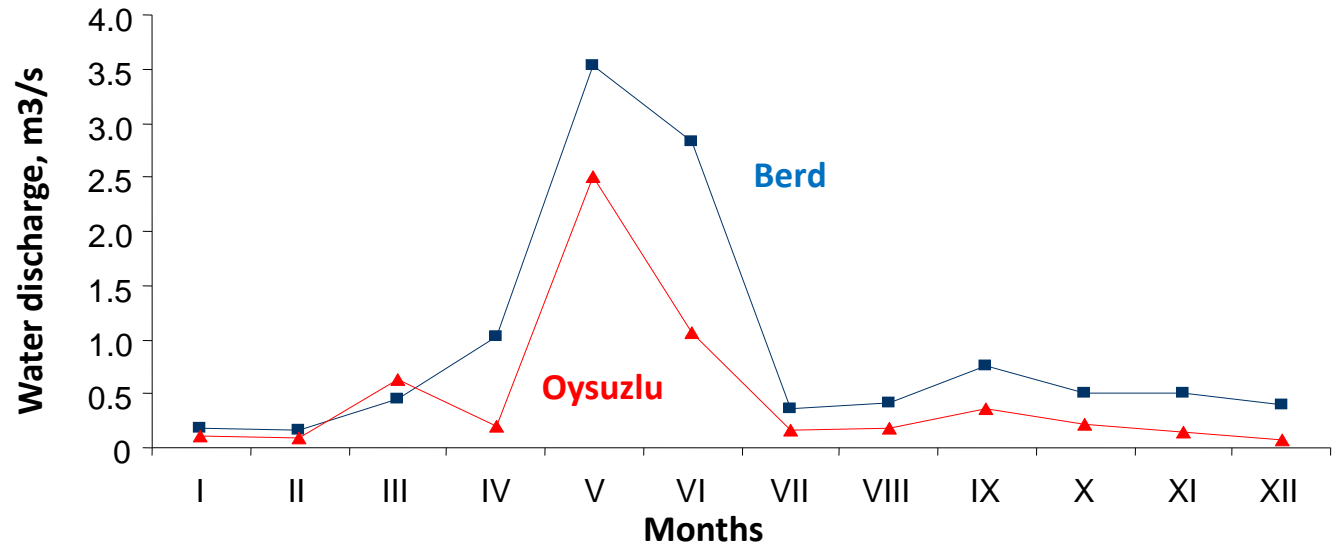
Impacts from human activities

- Change in natural flow regime of rivers.

- Deterioration of water quality and ecological state.

- Drying up of river flow, from excessive withdrawal for irrigation, and storage in reservoirs.

Monthly water discharges at Berd (upstream, blue) and Oysuzlu (downstream, red), Tovuzchay River

E-flow approach

Former Soviet Union

- Medium-sized rivers – maintain annual flat flow rate equal to 75% probability of lowest average monthly flow

New proposal

1. Specific for each month, no annual flat rate.
2. Based on natural flow, before anthropogenic impact.
3. Observed monthly Q_{min} as 1st approximation for E-flow value.
4. Correction ΔQ_1 : statistical analysis of long-term changes in monthly discharge. **Account for Climate Change**
5. Correction ΔQ_2 : statistical analysis of intra-monthly variation coefficient. **Account for natural variability**

Final formula: $Q_{ef} = Q_{min} - \Delta Q_1 + \Delta Q_2$

Proposed new E-flow approach

In Practice

1. Calculate long-term average monthly flow for anthropogenic impact period ($Q_{observed}$).

2. Compare monthly $Q_{observed}$ with monthly Q_{ef}

3. If monthly $Q_{observed} \geq Q_{ef}$, then E-flow is provided, otherwise not

4. Water available for extraction: ($Q_{abstract}$) based on Q observed, corrected for Q_{ef} :

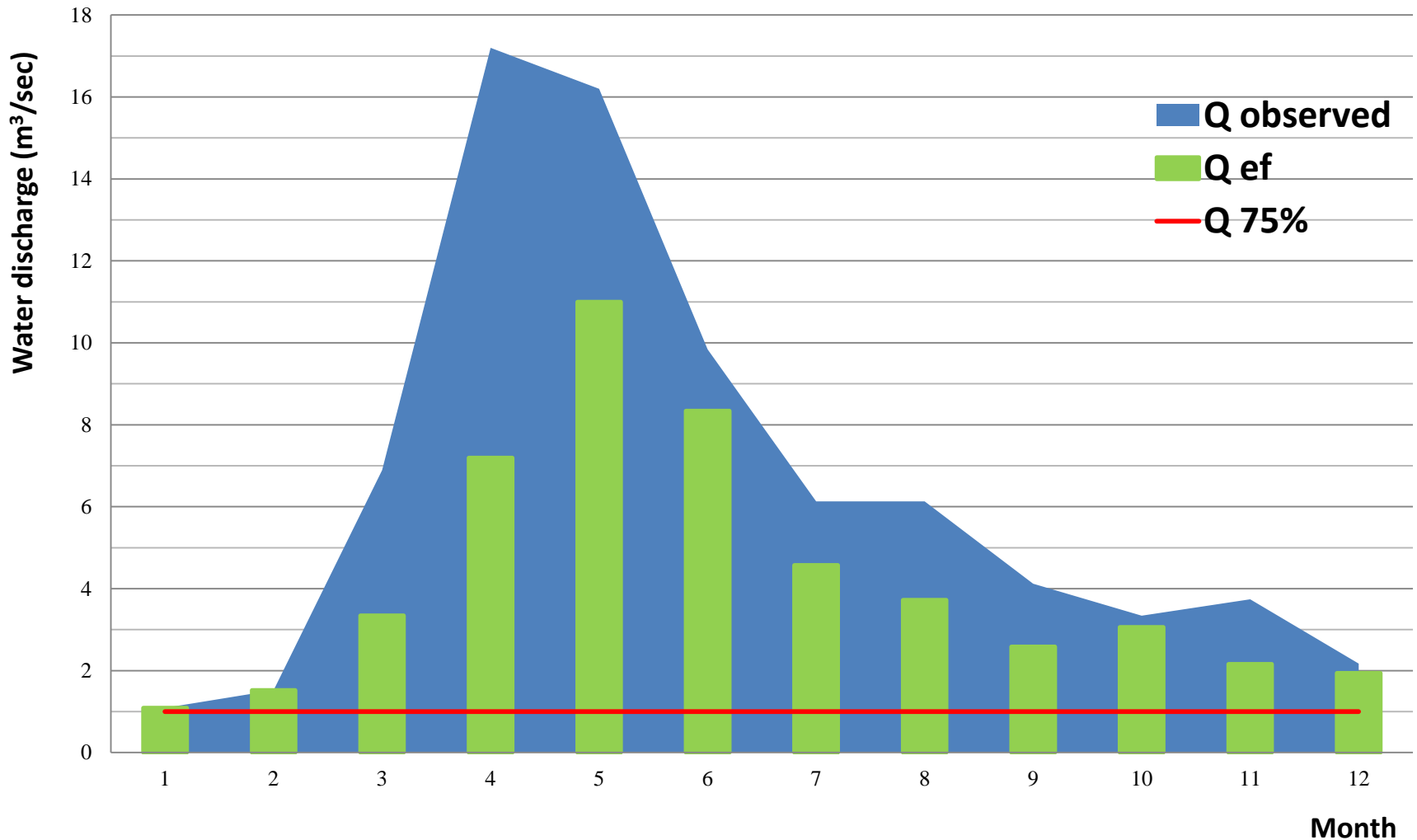$$Q_{abstract} = Q_{observed} - Q_{ef}$$

New E-flow – practical application

Gancachay upstream
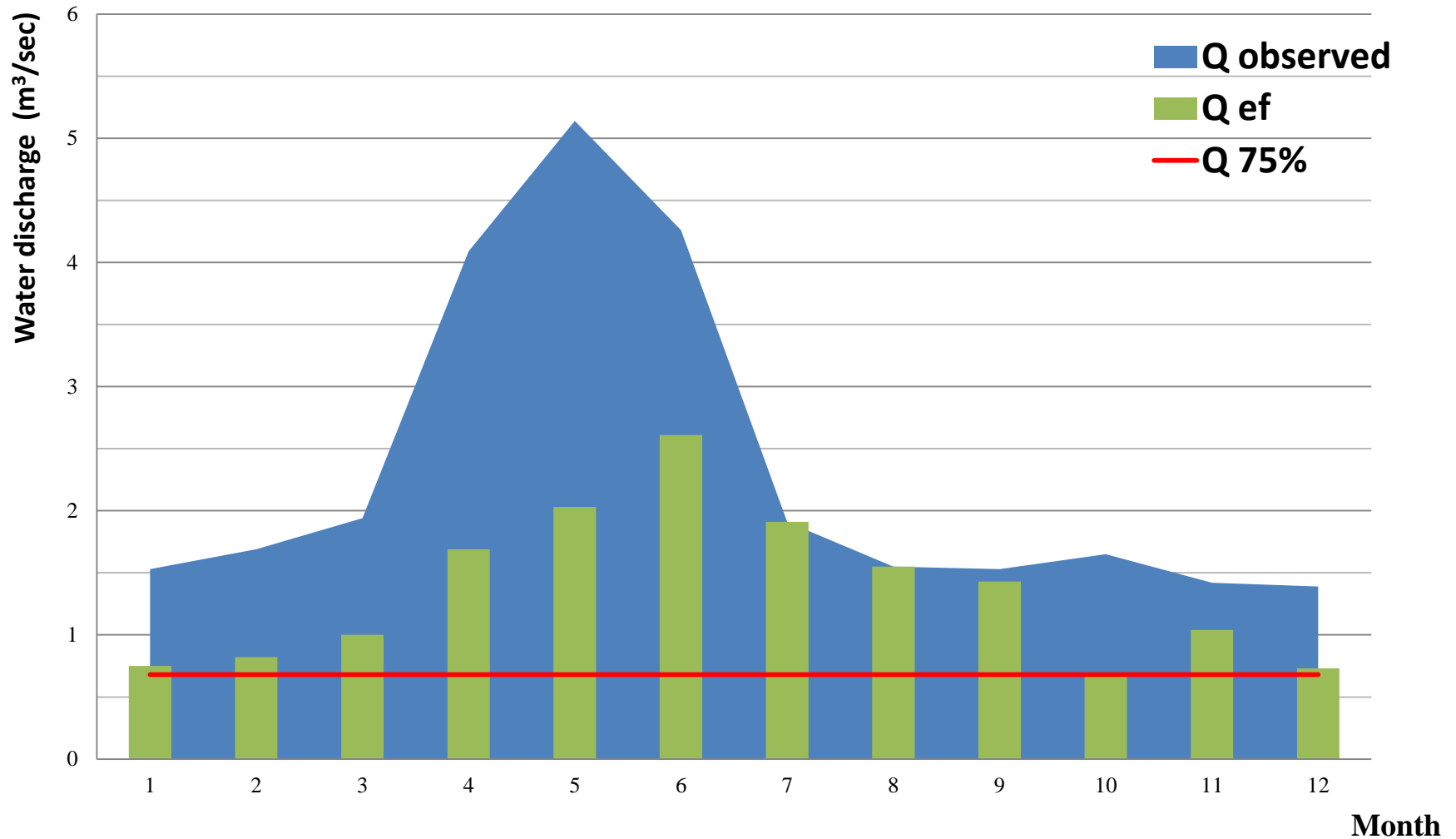
New E-flow – practical application

Shamkirchay middle section

Recommendations

- **E-flow hydrographs** for pilot tributaries were calculated from statistical analysis of long-term discharge time series.

- Proposal prepared to adopt **new government regulations**, to guide water abstraction licensing for economic use.

- E-flow only (first) part of solution. Recognized need for:

    - *Addressing land use in floodplains and beyond.*

    - *Active **restoration of aquatic ecosystems**.*

    - Improved **science & monitoring.**

Thank you for your attention