

**UNIVERSITÀ DEGLI STUDI DI BOLOGNA**  
*Exercise of Advanced Hydrology M*

**Application of pairwise comparison for estimating the optimal design flow for a hydropower plant**

A small hydropower plant (with no regulation) is to be designed for a cross river section. The design flow can assume values of 80, 90, 100, 110 or 120 l/s. After a careful assessment of the environmental and economical behaviors of the project the following indicators have been identified for evaluating the most appropriate alternative:

- 1) The economical benefit – I1
- 2) The impact on the fish community – I2
- 3) The impact on the landscape – I3
- 4) The fruition of the downstream river reach for recreational purposes – I4

The utility functions associated to the above indicators, depending on the design water withdrawal, are reported in the following tables.

Indicator I1

Design flow	U(I1)
0	0
30	0
150	1

Indicator I2

Design flow	U(I1)
0	1
60	1
150	0

Indicator I3

Design flow	U(I1)
0	1
100	1
150	0

Indicator I4

Design flow	U(I1)
0	1
10	1
100	0
150	0

The optimal river flow withdrawal should be identified by using pairwise comparison, by making sure that the evaluation is consistent.