WHEN POLICY IS QUESTIONABLY PUT IN PRACTICE MISLEADING APPLICATION OF DESKTOP FORMULAS FOR RESERVED FLOW CALCULATION AN ITALIAN CASE STUDY

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CONCLUSIONS

- Large scale planning conflicts with site specific situations and penalise them
- It's evident the necessity for the regulator of having a desktop formula for planning reasons, but….
- Desktop formulas can hardly describe specific site conditions

MORE CONCLUSIONS

- It’s wrong in principle to plan water resource management on the basis of regionalisation algorythms : it’s quite better no planning at all, but in this way the power of bureaucratic apparatus disappears

DEFINITIVE CONCLUSIONS

- Small hydro plants owners must be positive and propose a voluntary approach to reserved flow determination based on experimental data. In most cases the game is worth the candle and the economics of the plant can bear the expenses of a site specific study

SHORT LIST

- Regional Law nr. 25/1982
- National Law nr. 183/1989
- National Law nr. 102/1990
- Act 6/1992 Po River Basin Authority
- National Decree nr. 275/1993
- National Law nr. 36/1994
- Regional Act nr. 7/2604/2000
- National Decree nr. 152/1993
- Act 7/2002 Po River Basin Authority
- Regional Water Protection Plan 2005
- ……

SHORT FORMULAS

$$RF = \left(-2.00 \cdot 10^{-5}\, S + 0.14\right) \cdot \left(0{,}004204856 \cdot H + 0{,}02302933 \cdot P\right) \cdot S \cdot M \cdot Z \cdot A \cdot T$$

$$RF = \left(0.052 \cdot S^{0.068232} \cdot q_{mean}{}^{0.234733} + \frac{0.4689}{q_{mean}} \right) \cdot q_{mean} \cdot S \cdot M \cdot \max(N,F,Q) \cdot A \cdot T$$

$$RF = 0{,}1 \cdot \left\{ \frac{1}{T} \cdot \int_0^T \varepsilon + (\lambda - \varepsilon) \left[-\ln\left(\frac{\vartheta}{365} \right) \right]^{\frac{1}{\beta}} d\vartheta \right\} \cdot S \cdot M \cdot Z \cdot A \cdot T$$

$$E = m \cdot c^2$$

THE PLANT

• nominal average flow rate	0,530	m^3/s
• rated discharge	1,20	m^3/s
• gross head	71,90	m
• nominal power output	373,5	kW
• installed capacity	655	kW
• annual production	3	GWh
• length of the depleted reach	3,4	km
• catchment area	100,5	km^2

1993 – FIRST OBLIGATION

- Based on the catchment area (~ 4 l/s/km^2)
- Reserved flow = 393 l/s!!!
- Expected energy loss: > 60 %!!
- Reserved flow never released

2003 – THE GREAT CHANCHE

- Reserved flow ~ 10% of Q_{mean}
- Q_{mean} derived from energy production
- Proposed reserved flow = 55 l/s

2004 – THE BUREAU ANSWER

- “Safety factor” against owner dishonesty = 2

- Official reasons (not better specified): the river has

1. “environmental value ”
2. “hydrological and hydro-geological peculiarities”

- New reserved flow obligation = 55·2 = 110 l/s

- Loss of annual income ~ 40.000 €

2005 – AGAINST DESKTOP FOMULAS

- Direct flow rate measurements at different distances downstream of the weir
- Hydro-biological evaluation of the status of the river with different values of reserved flow released (including no reserved flow)

REALITY VS. FORMULAS

- $Q_{formula} = 3{,}15\ m^3/s$
- $Q_{real} = 0{,}69\ m^3/s$
- “Safety factor” = 4,5

REALITY VS. FORMULAS

- Just downstream the weir

- No RF
- 128 l/s RF

REALITY VS. FORMULAS

- Effect of tributaries (low flow period)

- No reserved flow

REALITY VS. FORMULAS

- Effect of tributaries (low flow period)

- No reserved flow

PICTURES MISLEADING?

- Let figures talk

Abiotic parameters measured downstream of the weir

		No RF	RF = 110 l/s	Difference
Velocity	[m/s]	0,36	0,56	-0,20
Depth	[m]	0,04	0,07	-0,03
Wetted area	[m^2]	0,18	0,35	-0,17
Wetted perimeter	[m]	5,07	5,14	-0,07

PICTURES MISLEADING?

- Let figures talk

Abiotic parameters at the end of the depleted reach

		No RF	**RF = 110 l/s**	**Difference**
Velocity	[m/s]	0,61	0,67	-0,06
Depth	[m]	0,08	0,09	-0,01
Wetted area	[m^2]	0,80	0,92	-0,12
Wetted perimeter	[m]	10,16	10,18	-0,02

PICTURES MISLEADING?

- Let figures talk
- No Reserved Flow

EBI	**Class**	**Description**	**Color**	Status
8	II	Environment with some evidence of pollution effect	***Green***	***Good***

WHAT ABOUT MONEY?

- Cost of the study: ~ 10.000 €
- Annual loss of energy (RF 55 vs. 110 l/s):
  270.000 kWh
- Annual loss of income (RF 55 vs. 110 l/s):
  > 40.000 €

THE END