RISK MANAGEMENT UNDER CLIMATE CHANGE CAN SERIOUSLY SUPPORT NATURE CONSERVATION & RIVER RESTORATION

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20 April 2023

Foto: Burtynsky

...certainly not a mainstream presentation

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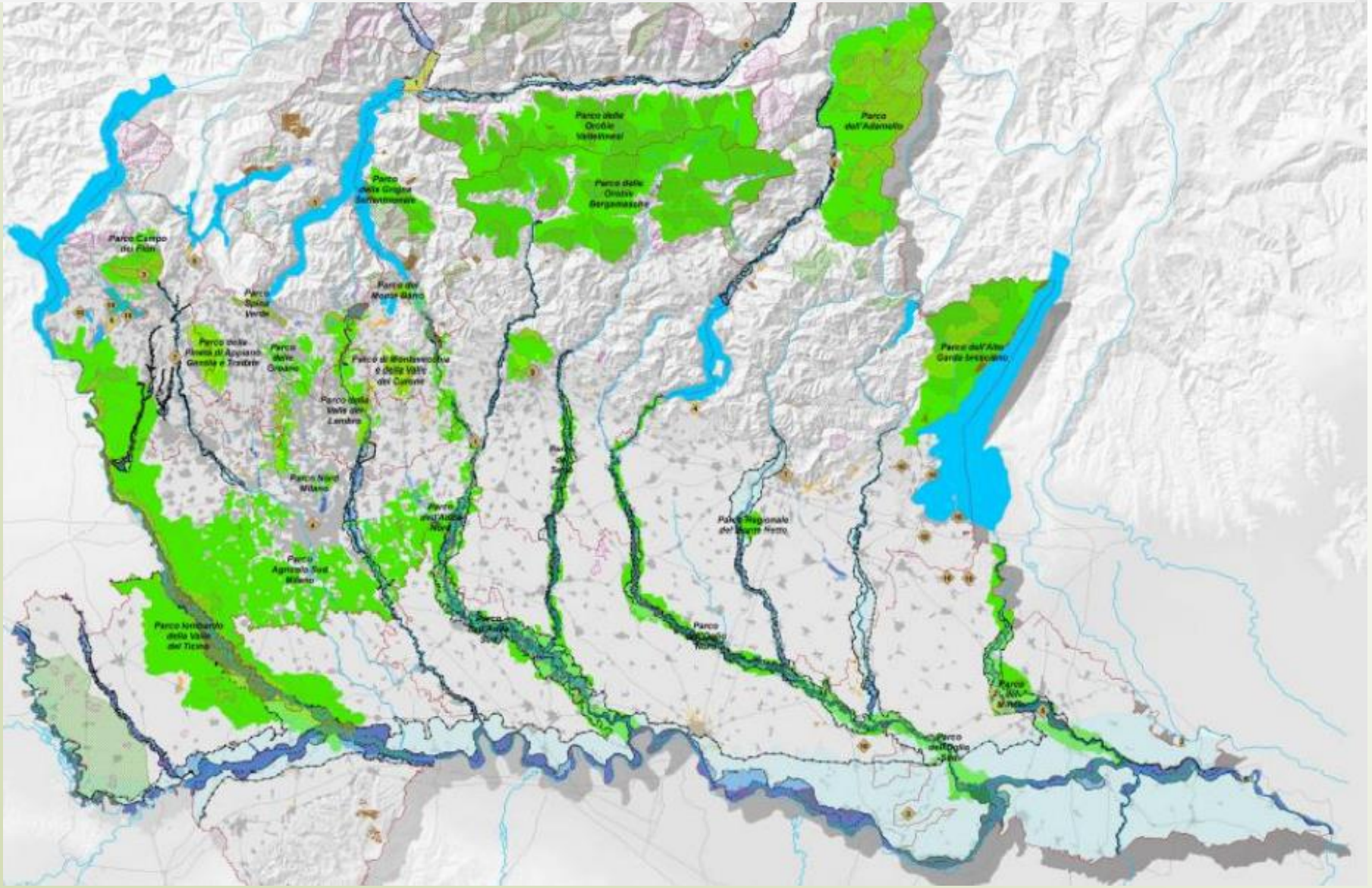
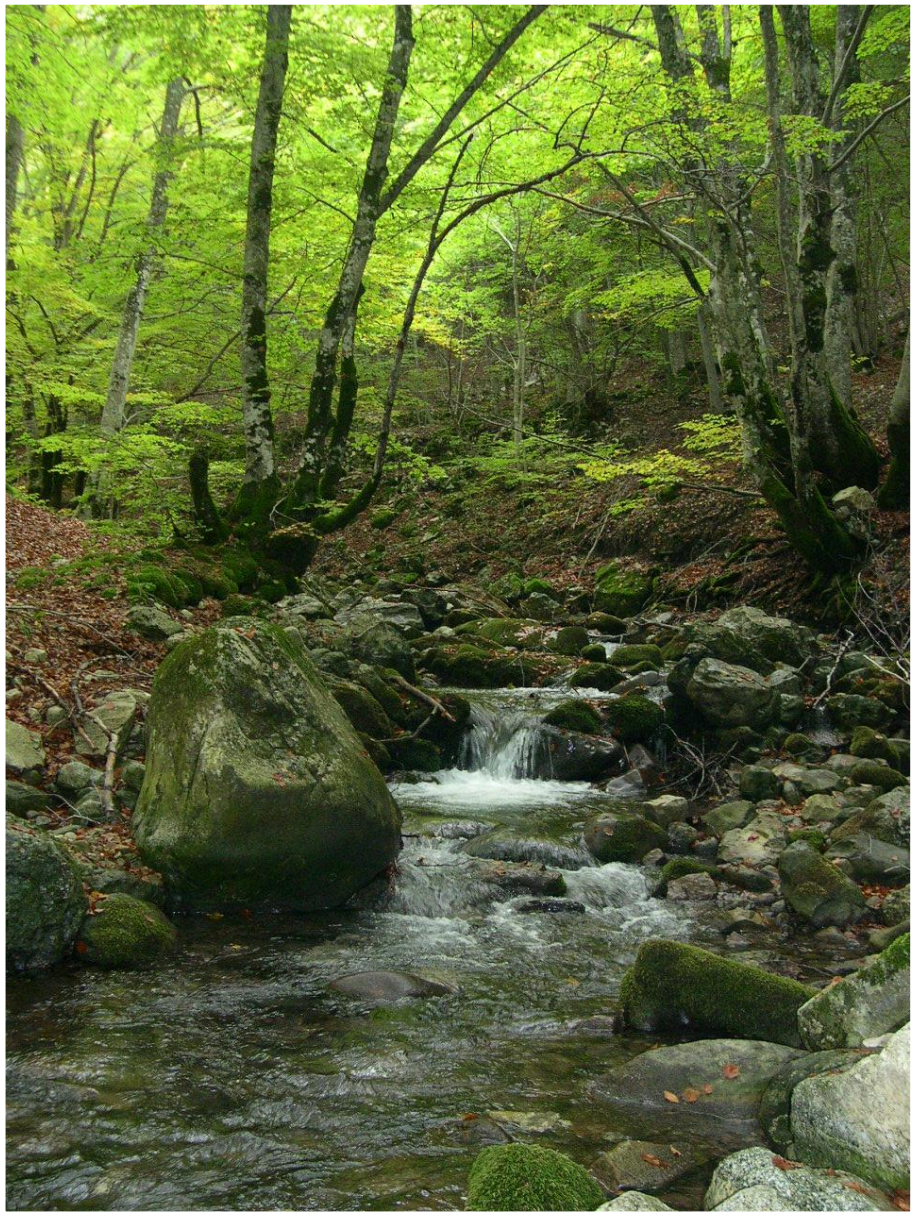
Nature conservation: more than a collection of nature islands

Rivers: the most natural connectors



Bellissimi…



Aspromonte (Italia)

bellissimi…

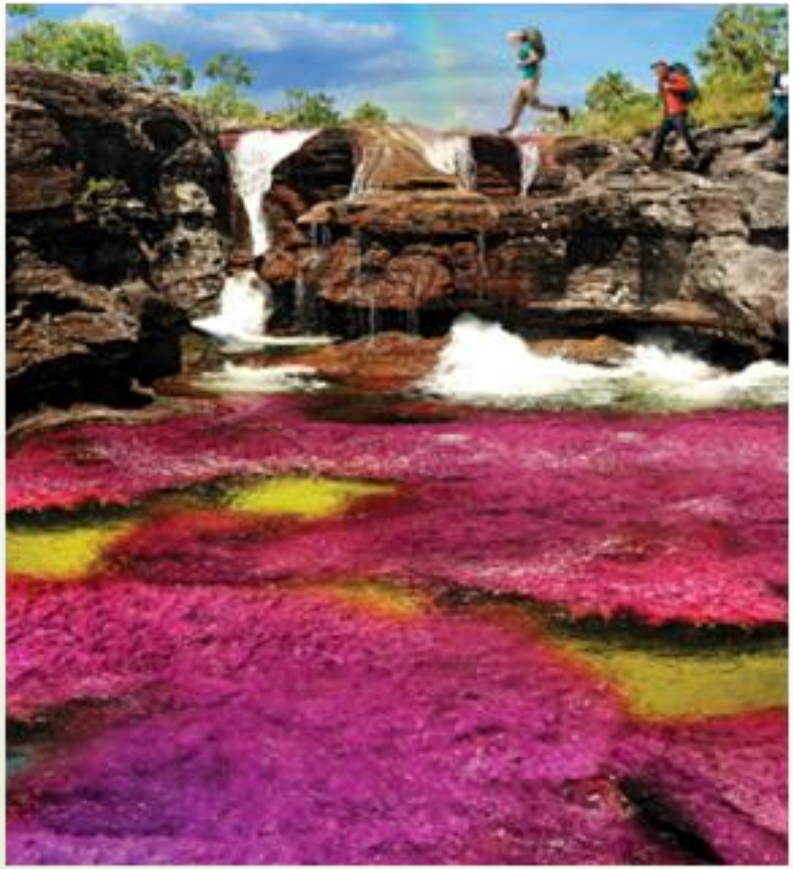
Alto Chiese in Val di Fumo (Daone, Italia)


bellissimi…
Rio Ara, Pirenei (Spagna)


bellissimi…
Ahuriri, Nuova Zelanda (isola del Sud)

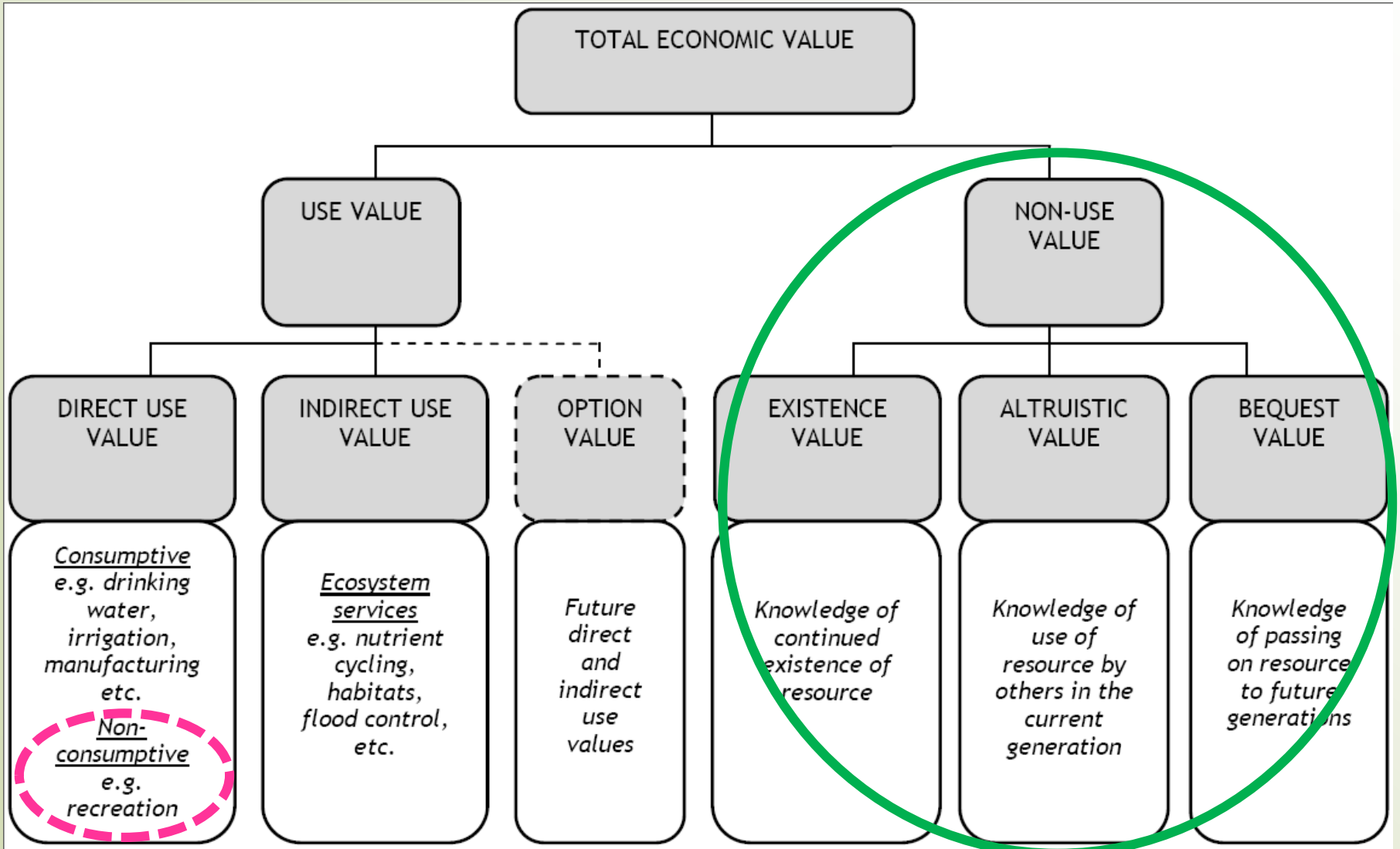
Rio Ibáñez, Patagonia, Chile – octubre 2011

El Caño Cristal (La Macarena, Dep.tp Meta, Colombia) (source:http://www.cano-cristales.com/)



bellissimi…

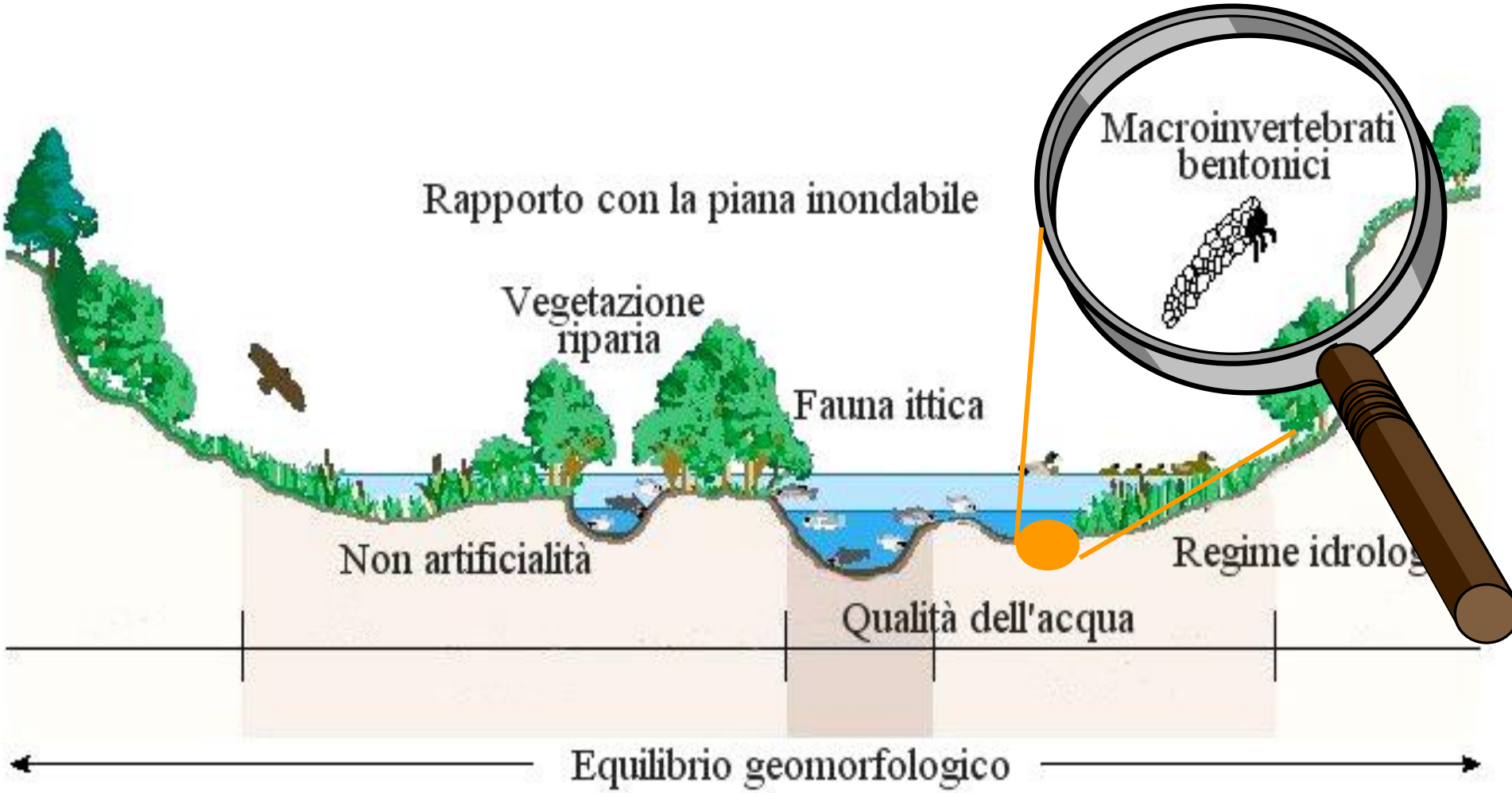
Why to conserve & restore? ecosystem VALUE



Water and the *Total Ecosystem Value-TEV*. Source: EFTEC (2010; Box 2.1, pag.5).

Centro Italiano
per la
Riqualificazione Fluviale

OBJECTIVE "HEALTH"

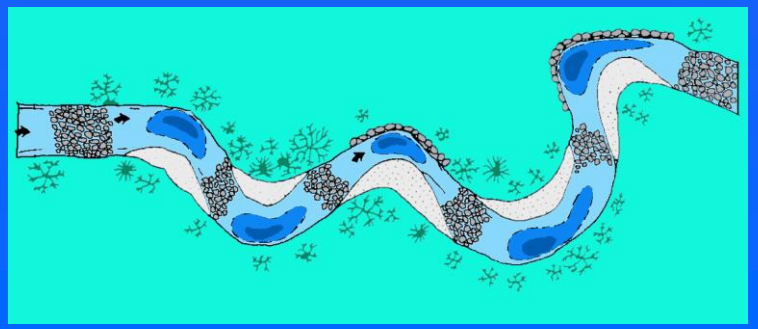


ASSESSING the ECOLOGICAL STATUS

WATER QUALITY

BIOTIC QUALITY

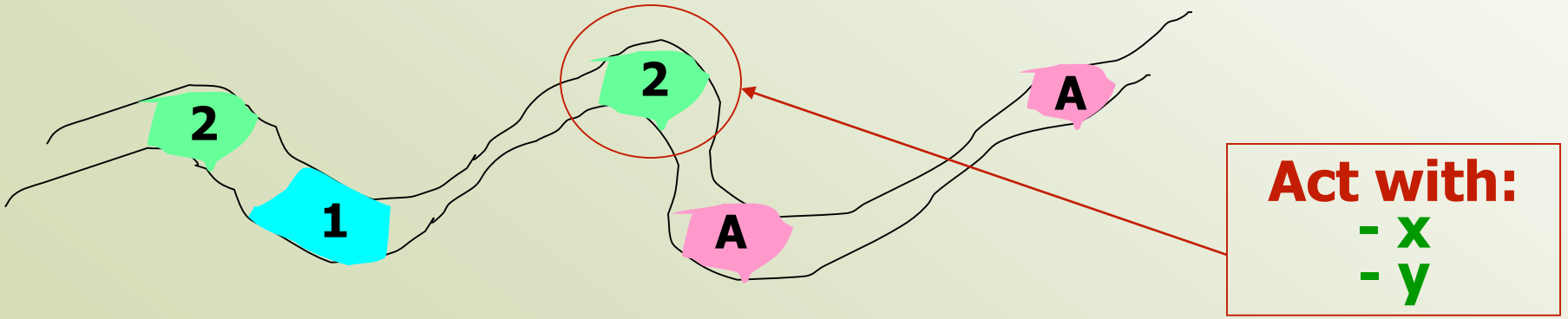
HYDRO-MORPHOLOGY (HyMo)



River Restoration STRATEGY

- Assess the ecological value of rivers

- Zonization/prioritization (different scales)



- Promote implementation creating advantages (norms)

RR ←→ MULTI-OBJECTIVE

Tourism

Water sports

Fishing

Hydro-electric production

Safety

Irrigation

Fluvial Ecosystem

RIVER RESTORATION….
GROUND FOR CONFLICTS

ECOLOGICAL GOOD STATUS

↓

Give back to the river its own space

↓

Impact on economic activities and settlement

↓

CONFLICTS…

RIVER RESTORATION….
GROUND FOR CONFLICTS

India's Greatest Planned Environmental Disaster: The Narmada ...
www.umich.edu/~snre492/Jones/narmada.html - Traducir esta página
"The State" (**India**) wants to build these **dams** on the Narmada River in the name of National **Development**. But "How can you measure progress if you don't know ...

HYDROPOWER and Water SUPPLY

Sustainable **Dam Development in India**
www.isn.ethz.ch/isn/Digital.../Detail/?... - Traducir esta página
This paper explores reforms in environmental and resettlement policies in ... and the influence of domestic and external actors on the reform process.

More **DAMS**

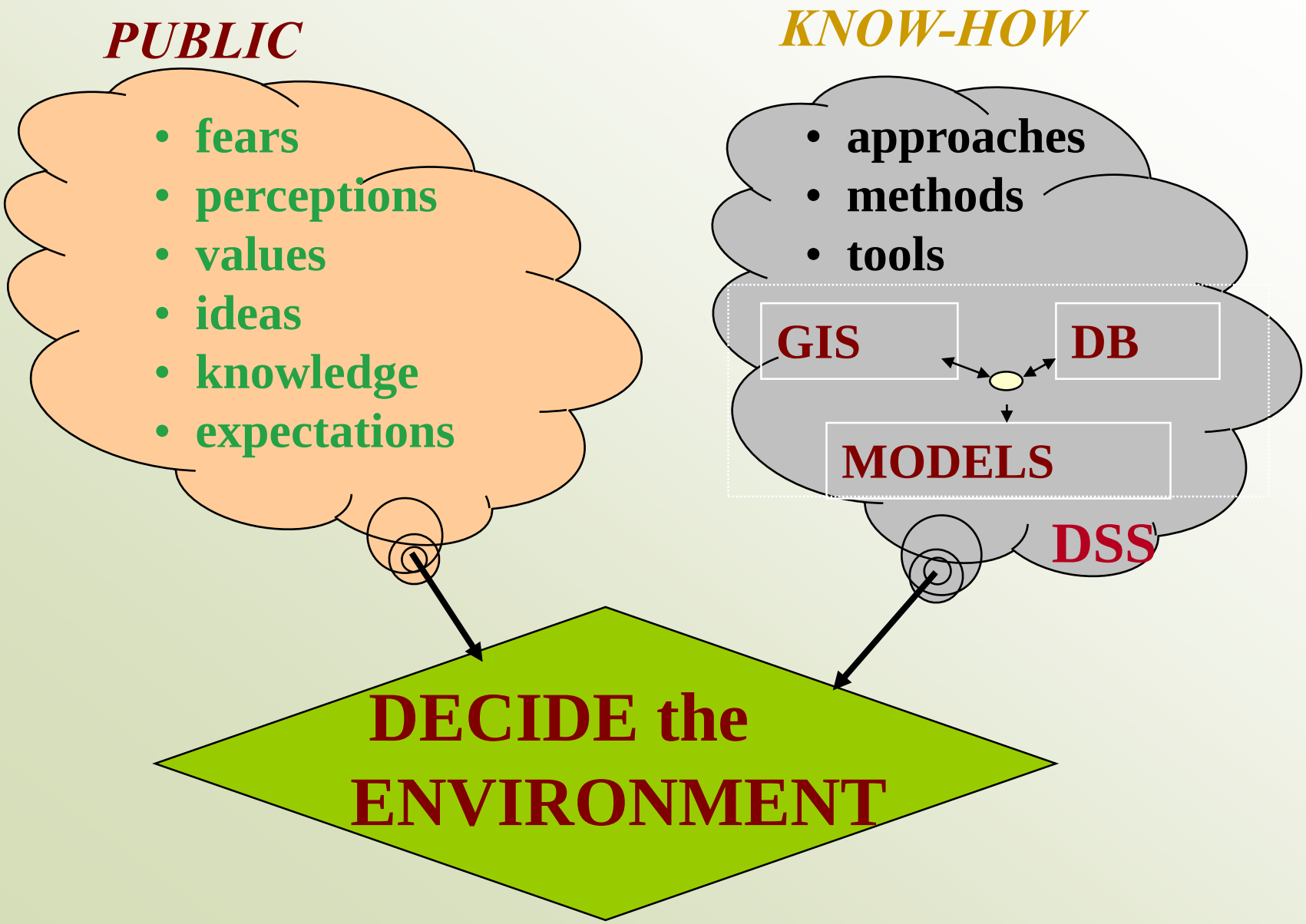
... Dams & Development – The Final Report of the World ...
www.talsperrenkomitee.de/...**dams/india_dams_d**... - Traducir esta página
Navalawala, B.N./ Gopalakrishnan, M.: Symposium.

Impact on water regime, quality,…

Tehri **Dam** - Wikipedia, the free encyclopedia
en.wikipedia.org/wiki/Tehri_Dam - Traducir esta página
It is the primary **dam** of the Tehri Hydro **Development** Corporation Ltd. and the ... **India** was forced to take control of the project and at first it was placed under the ...

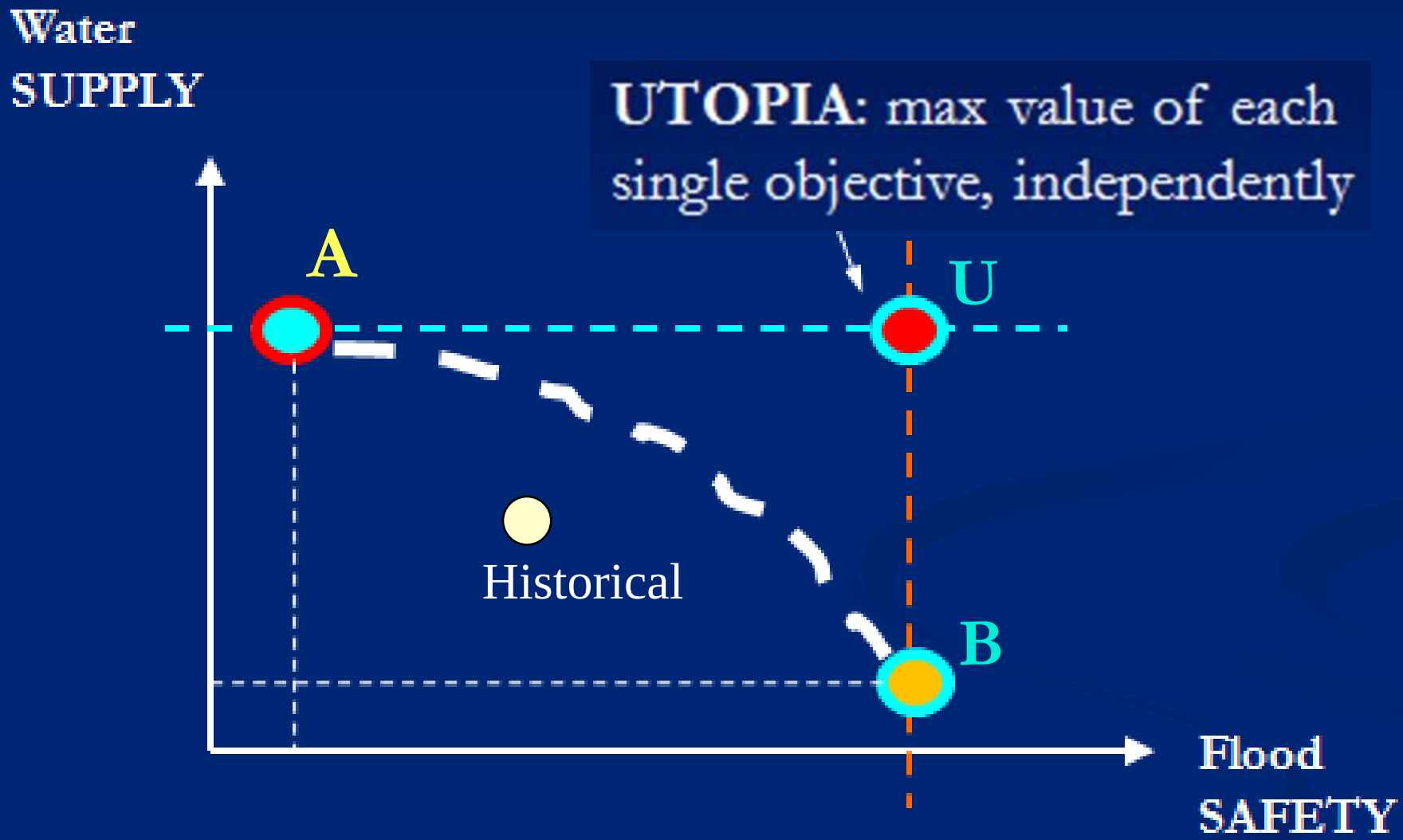
DEVELOPMENT-INDIA: Poor Pay Social Costs of Big **Dams** Without ...
www.ips.org/socialforum/0122/dev**india**.htm - Traducir esta página
30 Jan 2001 – **DEVELOPMENT-INDIA**: Poor Pay Social Costs of Big **Dams** Without Gain, says Global Report. By Meena Menon. MUMBAI, **India**, Oct 12 (IPS)- ...

CONFLICTS…


PUBLIC
fears
perceptions
values
ideas
knowledge
expectations
KNOW-HOW
approaches
methods
tools
GIS
DB
MODELS
DSS
DECIDE the
ENVIRONMENT

A RATIONAL DM PROCESS: KEY STEPS

from AMBIGUITY to CLARITY: MEASURING OBJECTIVES



MEASURING OBJECTIVES
is possible via VFs

The *multiattribute Value Function* is an extremely powerful and flexible tool the allow one to build evaluation indices

$$v(r,a) = \lambda_r v_r(r) + \lambda_a v_a(a)$$

$$v(c,a) = \begin{cases} \lambda_c v_c(c) + \lambda_a v_a(a) \\ \delta(c)[\lambda_c v_c(\gamma) + \lambda_a v_a(a)] \\ \lambda(a)[\lambda_c v_c(c) + \lambda_a v_a(\alpha)] \\ \delta(a)\delta(c)[\lambda_c v_c(\gamma) + \lambda_a v_a(\alpha)] \end{cases}$$

$$\delta(d) = \frac{1 - e^{k(d-\bar{d})}}{1 - e^{k(\tilde{d}-\bar{d})}}$$

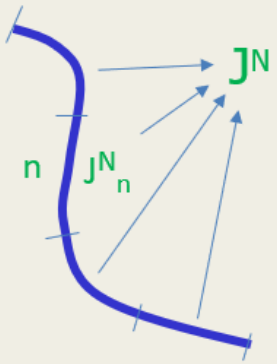
Generic spatial aggregation

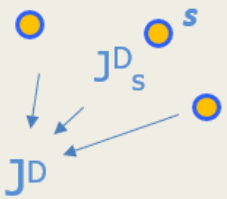
$$J^i_{corr} = \mathcal{A}_k [\, J^i_k \,]$$

Economic risk (J^R)

Ecological status (J^N)

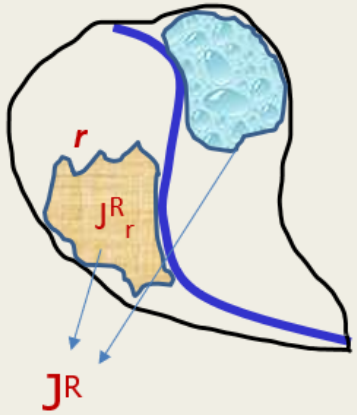
J^N_n : intensive variable associated with each *reach n*





J^D_s : intensive variable associated with each *site s*

Social disturbance (J^D)



J^R_r : extensive variable associated with each land plot r

River Restoration STRATEGY

- Assess the ecological value of

- Zo

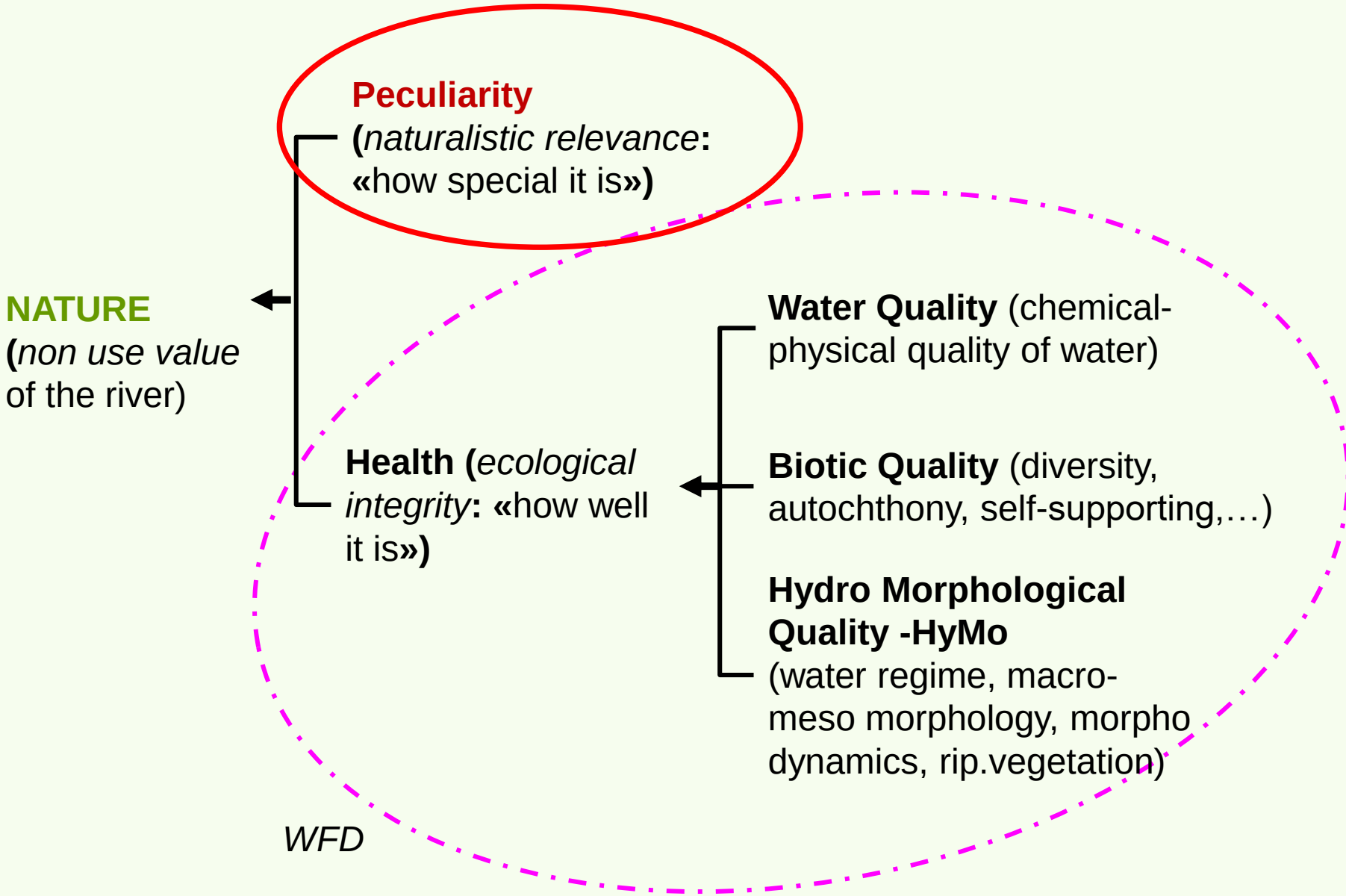
❑ To deal with multiple objectives, we need to measure the NATURE value of rivers

→ At least conceptually we should widen our assessment scheme :

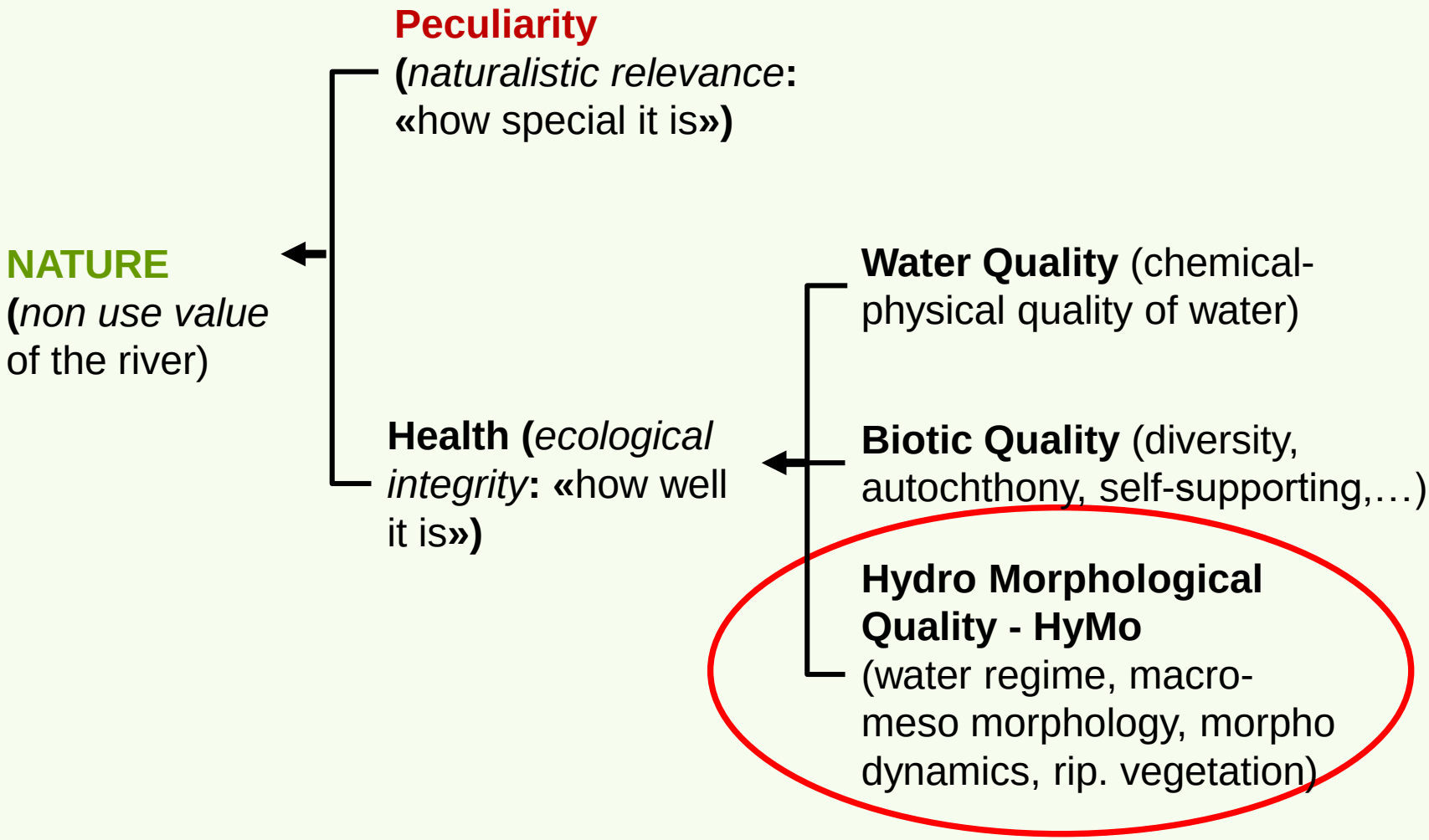
Act with:
- x
- y

- Promote implementation creating advantages (norms)

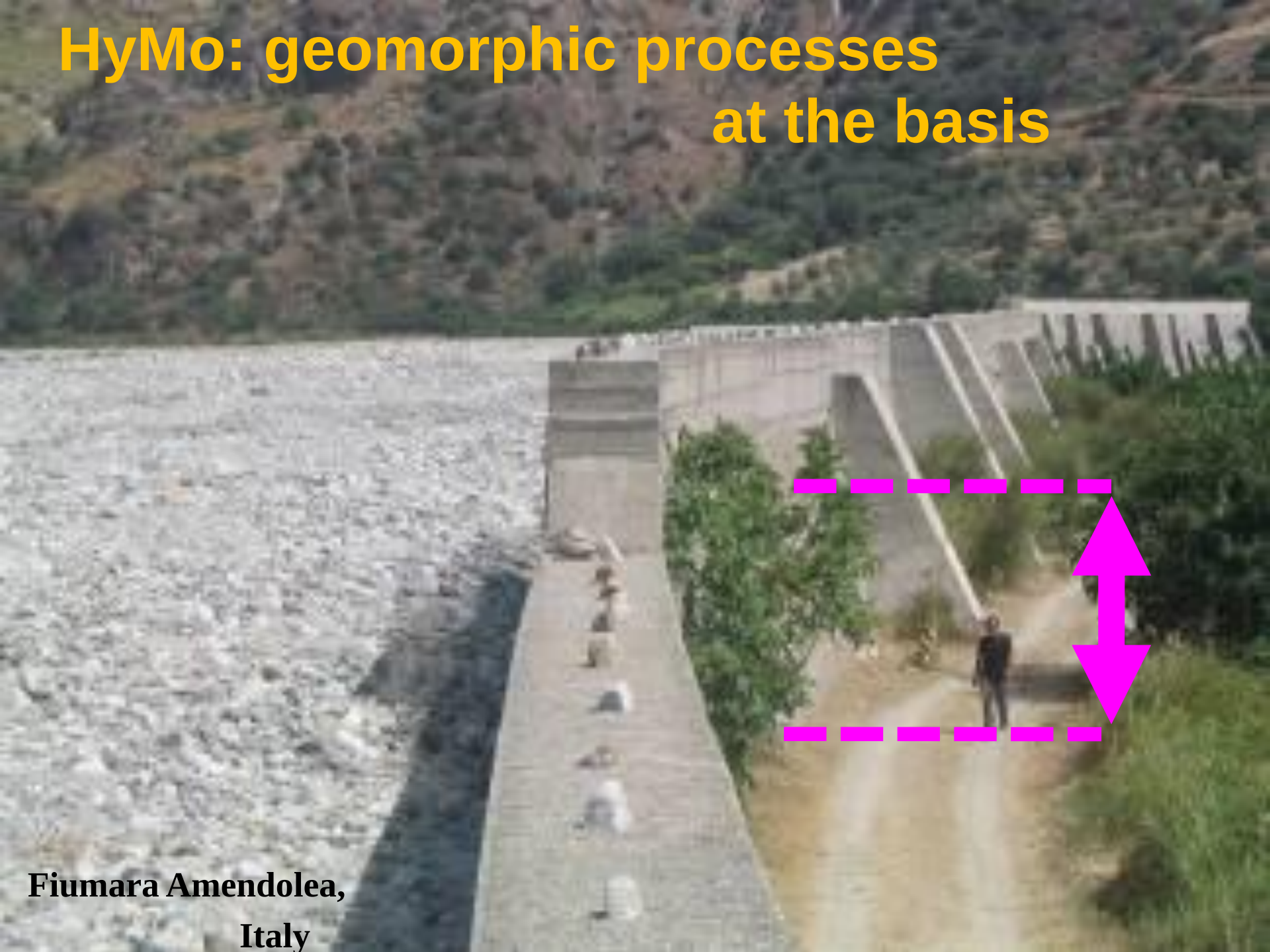
ASSESSING the … NATURE VALUE: a new entry key to restoration: *peculiarity*



ASSESSING the … NATURE VALUE



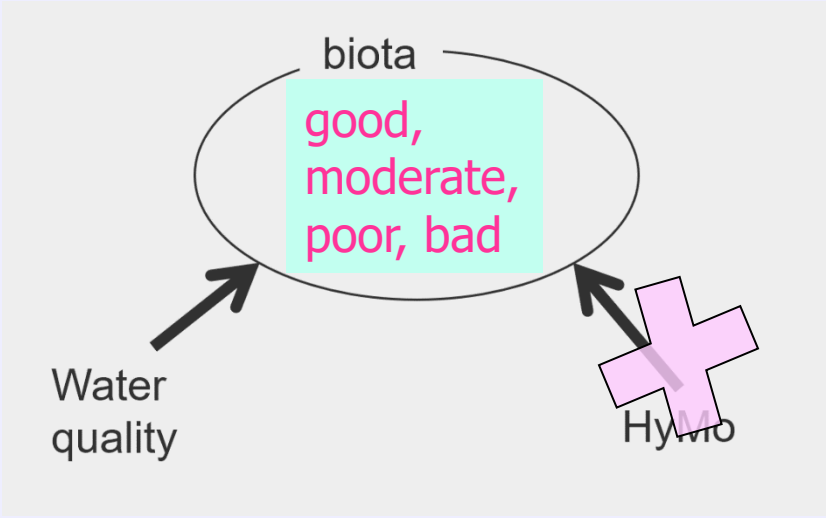
HyMo: geomorphic processes at the basis

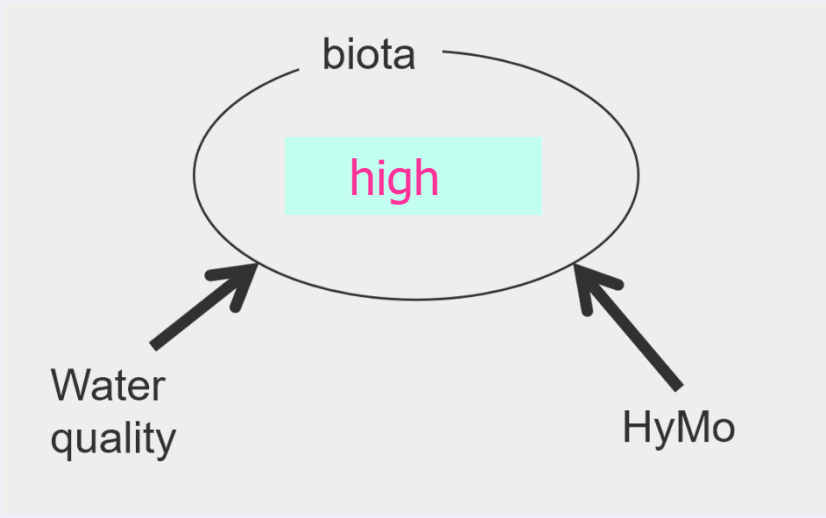


Fiumara Amendolea, Italy

A strange issue with HyMo:

Risk that the WFD does not bring us along the right way





- HyMo is just a causal factor: biota at the center
- HyMo comes into play only for *high status* of the biological compartment

TWO problems with HyMo:

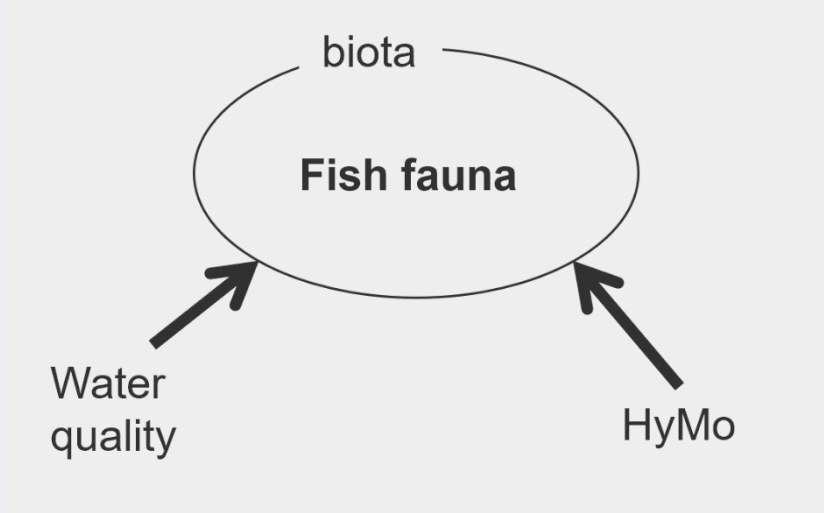
1) BIOTA-centric evaluation scheme

→ A measure transforming HyMo , certainly worsening the river ecosystem, may be totally transparent to the biota-centric assessment (i-initial status < high; ii- insufficient meso habitat attributes; inadequate indicators and/or biological monitoring scheme;…)

→ **Wrong & dangerous!**

TWO problems with HyMo:

1) BIOTA-centric evaluation scheme

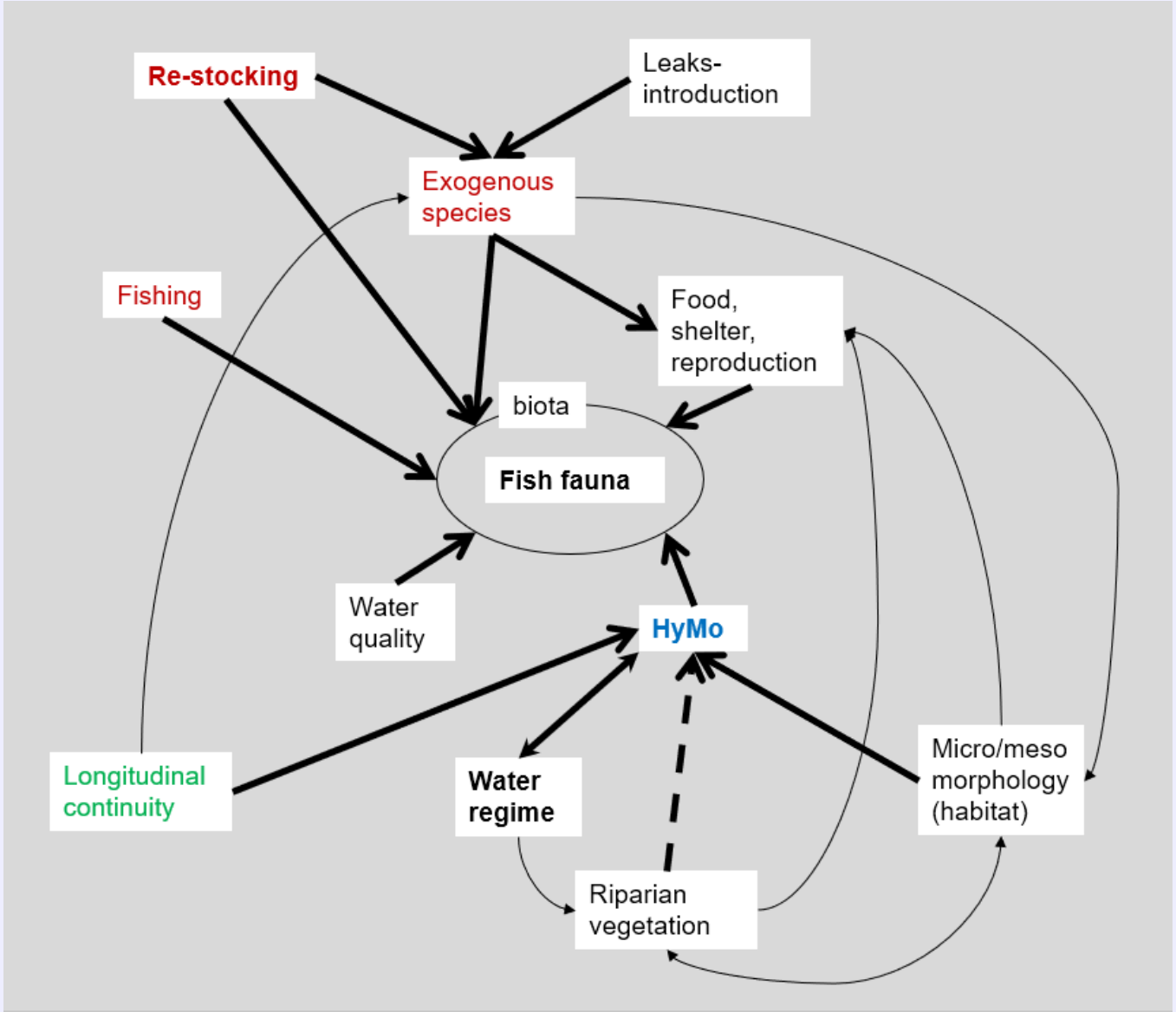


A measure aiming at improving the status via restoring the ***longitudinal continuity*** may **fail** to produce desired results because …

TWO problems with HyMo:

1) BIOTA-centric evaluation scheme

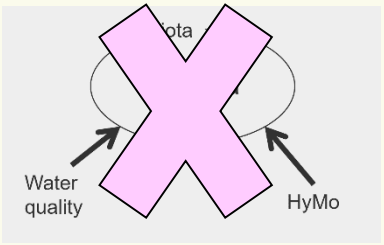
Several other factors may impede to see a fish fauna improvement manifested



TWO problems with HyMo:

1) BIOTA-centric evaluation scheme

- → **HyMo must be considered even for < high status**
- → **Each component deserves a role "per se" in the overall scoring**

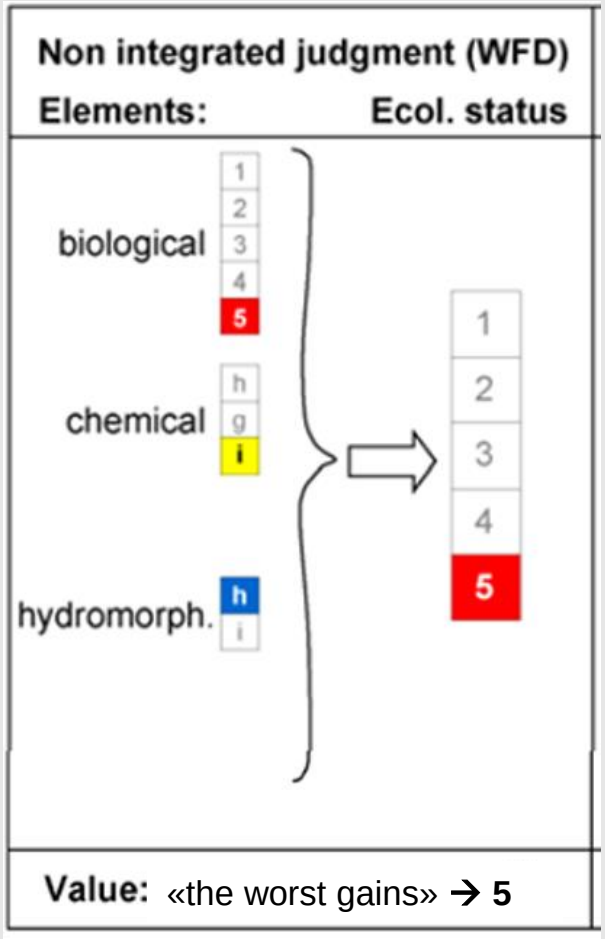


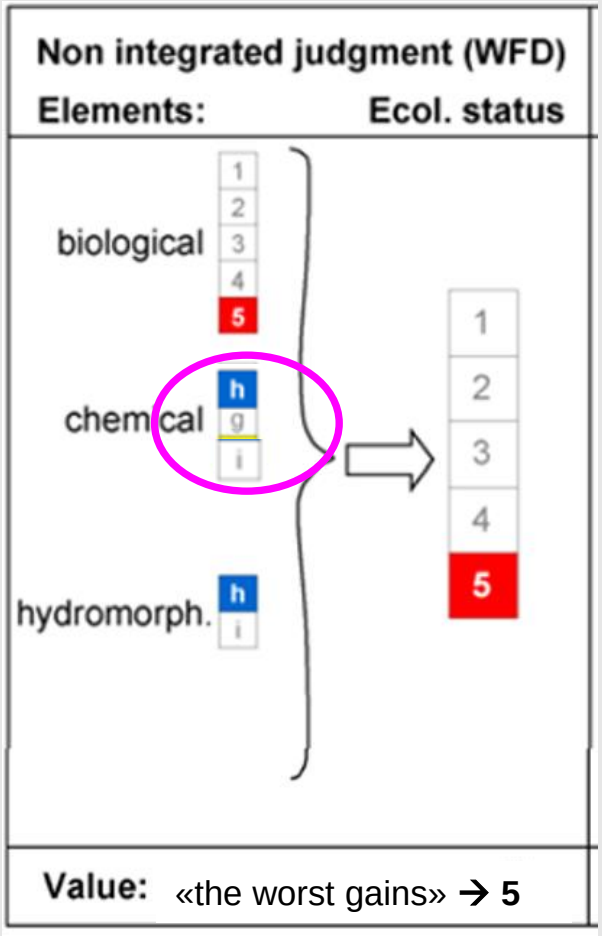
Fluvial ecosystem

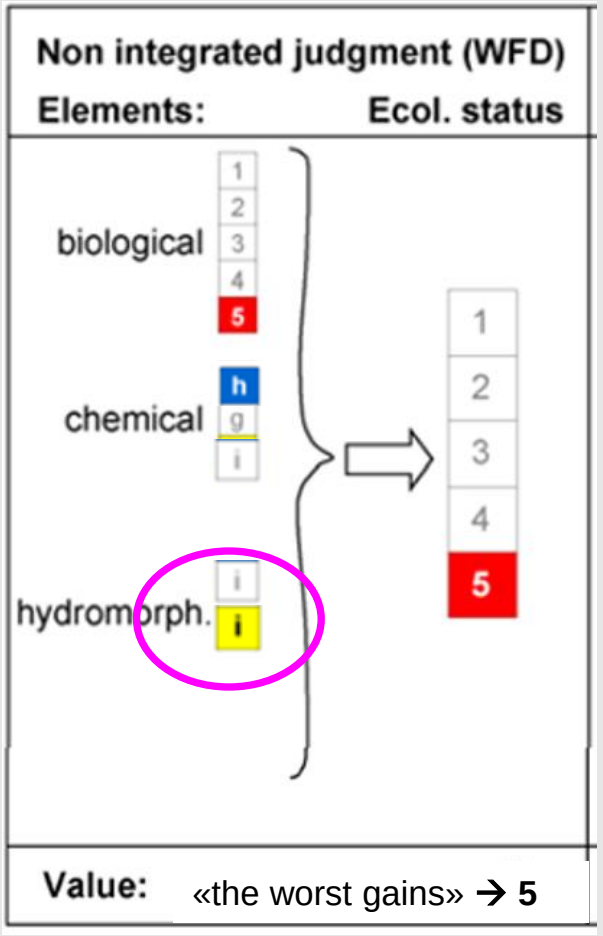
- Water quality
- Biota (fish fauna,…)
- HyMo

TWO problems with HyMo:

2) Inappropriate mathematical structure: the OOAO criterion



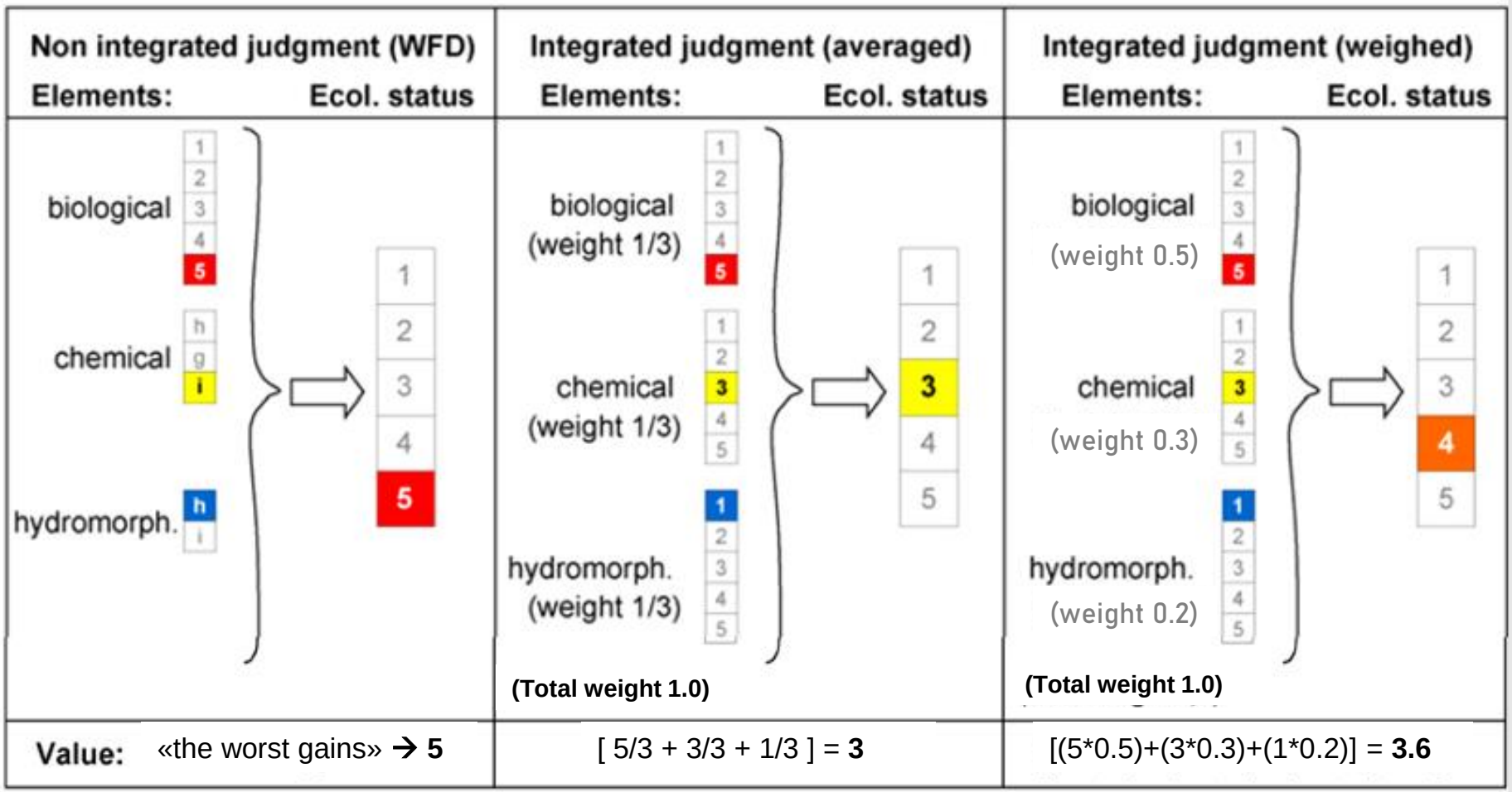




The One Out, All Out criterion does not bring justice in the ecosystem

TWO problems with HyMo:

2) Inappropriate mathematical structure: the OOAO criterion



→ **a suitable Value Function would solve the problem!**

Why this emphasis on the (already operating) Evaluation scheme ?

→ eventually, you must justify your action with measurable indices

→ An inappropriate assessment implies bad actions

→ HyMo or -better said- geomorphological comprehension of river character and behavior can illuminate on what has to be done now or on what may happen tomorrow

→ Several projects will first affect HyMo : dams, sediment mining, roads, defences,…

HYDRO-MORPHO RISK

← HYDRAULIC
(flooding)

MORPHOLOGICAL →
(fluvial dynamics)

HYDRO-MORPHO RISK

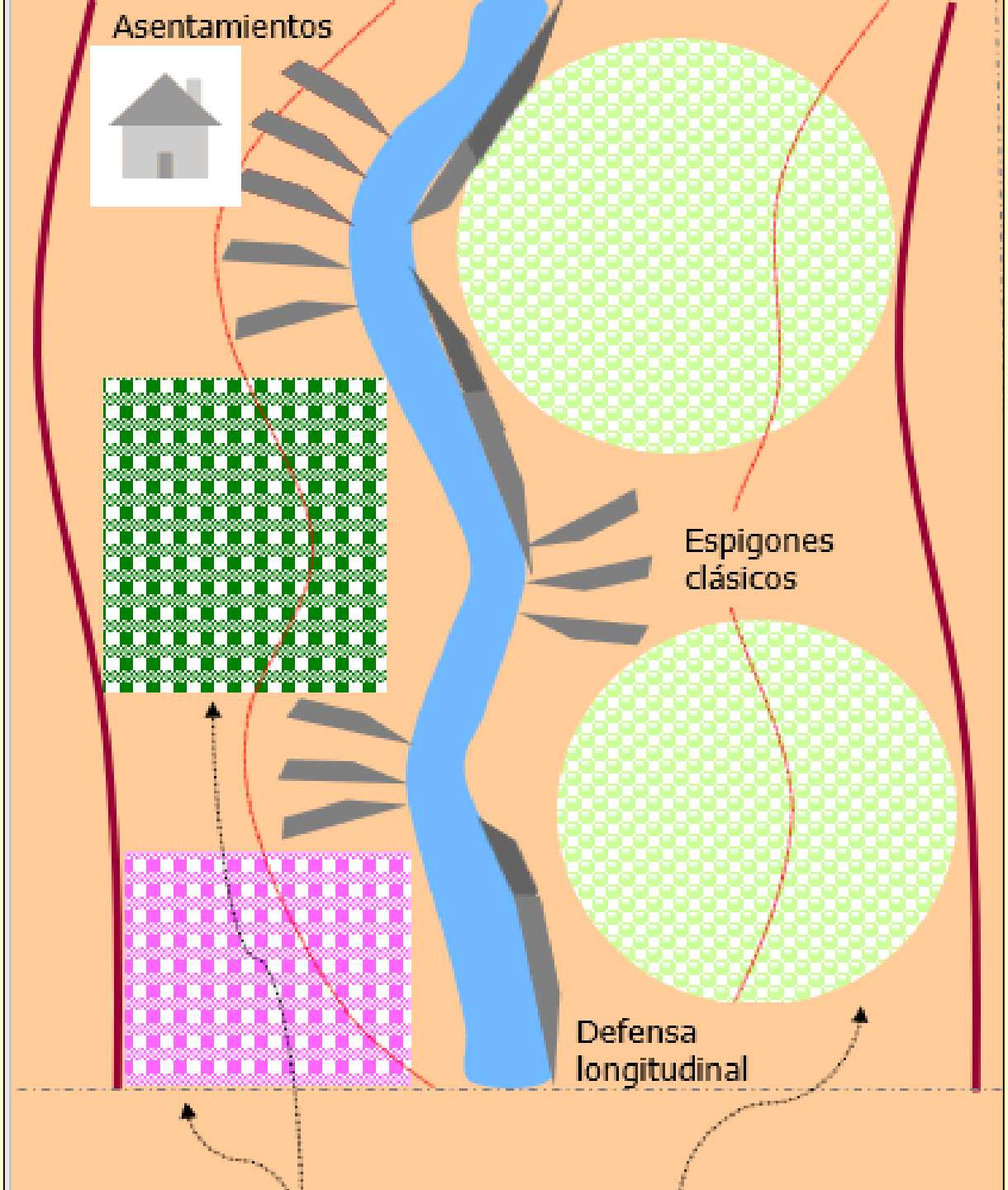
← HYDRAULIC
(flooding)

Engineering paradigm:

«achieve safety»

through
hydraulic works

MORPHOLOGICAL →
(fluvial dynamics)



- ***High risk***
- ***High management costs***
- ***Low ecological value***

Is this what we want

?

...eternal costs dumped on them

...sustainability?

infrastructuring =

Taxes in biberon!

Ministero delle Finanze

Carissimo neonato,

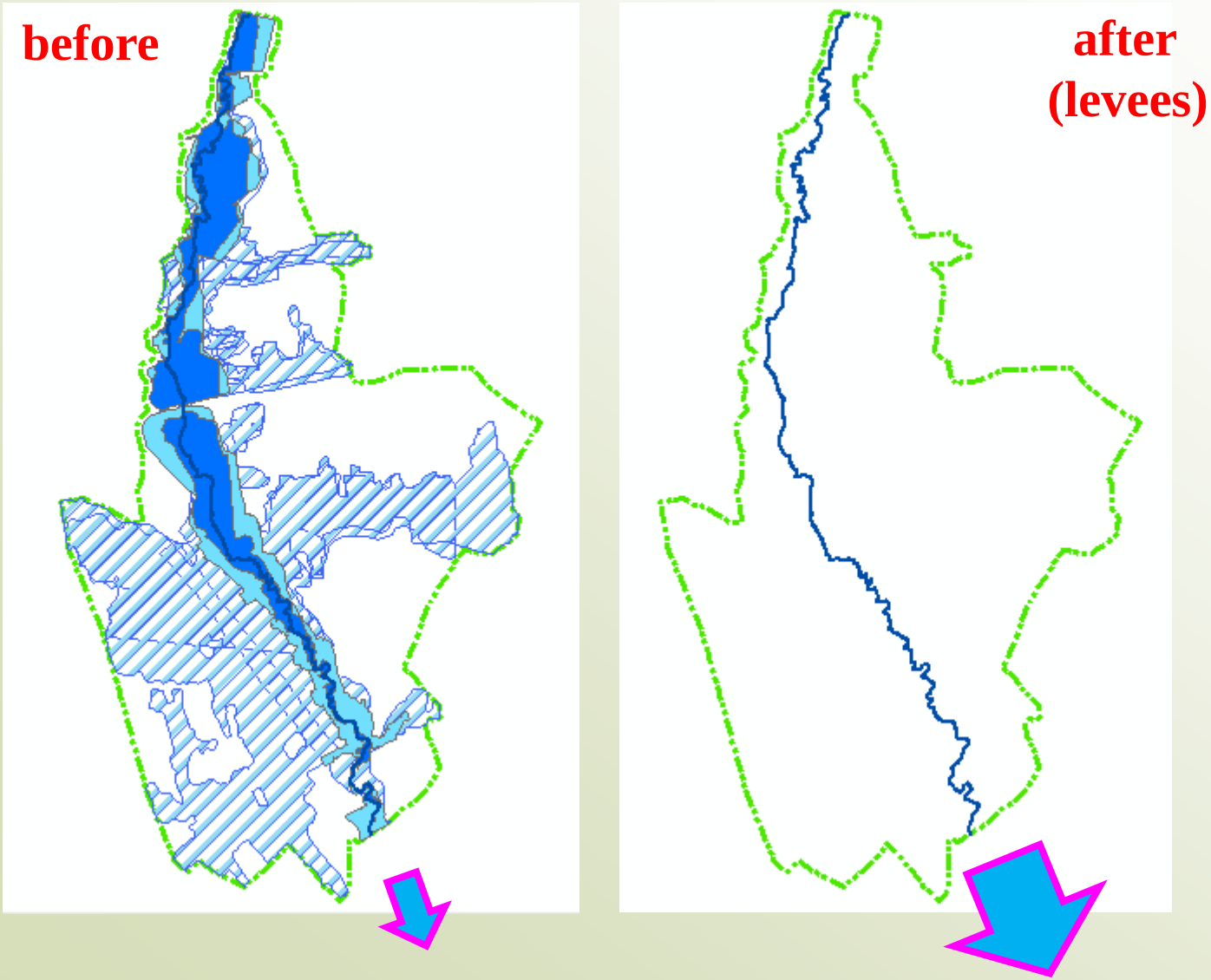
benvenuto in questo mondo! Ecco la tua prima cartella delle tasse sui fiumi

argini	€	25,00
difese spondali	€	17,00
briglie	€	9,80
dighe	€	7,50
taglio vegetazione	€	4,30
rimozione sedimenti	€	4,30
pulizia tombamenti	€	2,50
derivazioni	€	3,80
canalizzazioni	€	13,00
bonifiche	€	15,50
fognature	€	9,00
acquedotto	€	9,00
depurazione	€	5,60
pennelli e scogliere	€	13,80
ripascimenti	€	12,00
ponti	€	6,50
stabilizzazione frane	€	18,00
danni alluvionali	€	15,70
Protezione civile	€	9,75

ecc., ecc.

…just transfers the problem

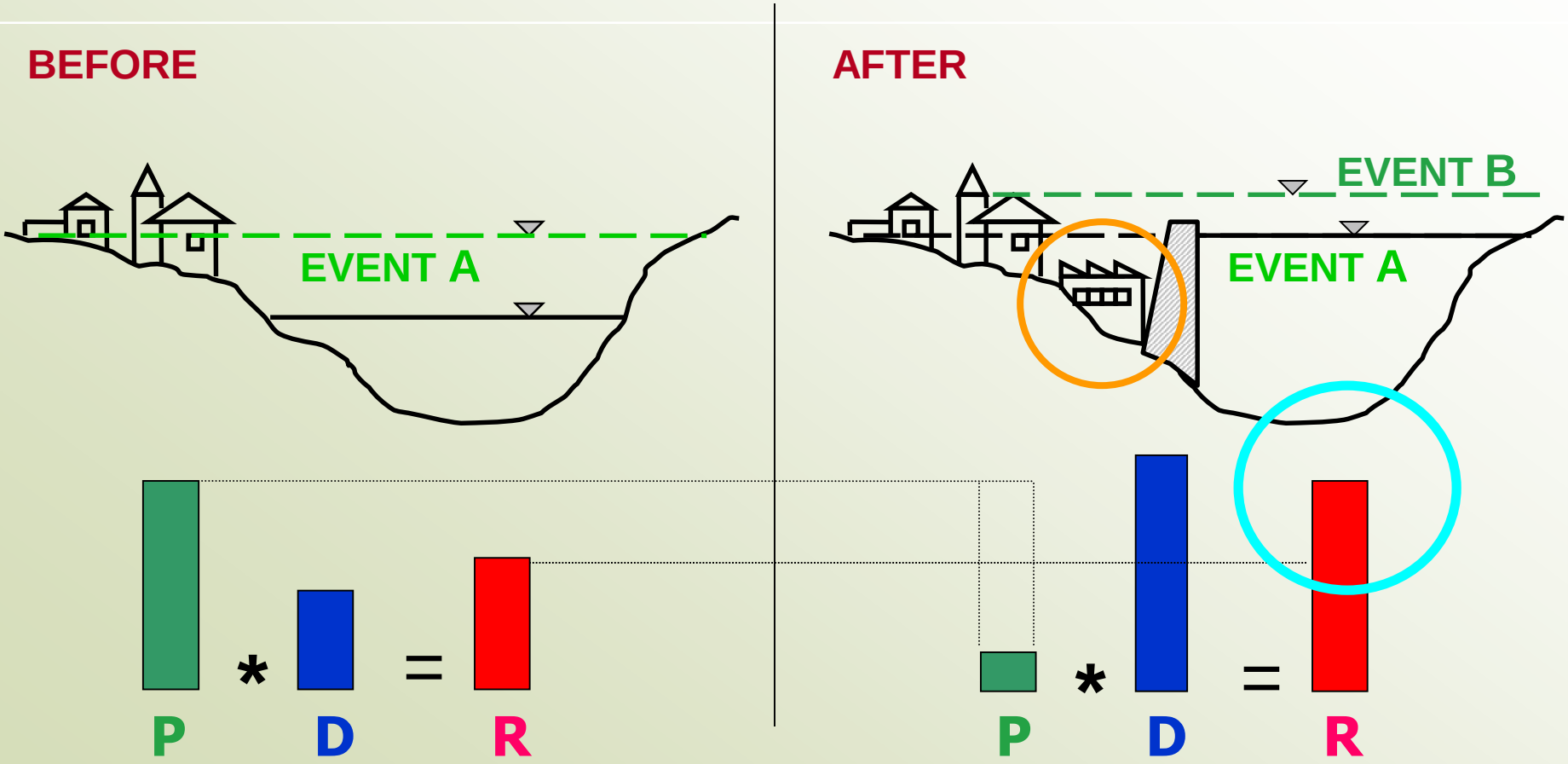
…i.e., externalities….



middle course of Lambro River (Milano Italy)

…levees in favor or against safety?

…i.e., false safety….



⇒ **risk has increased !!**

…fragility of the defence system

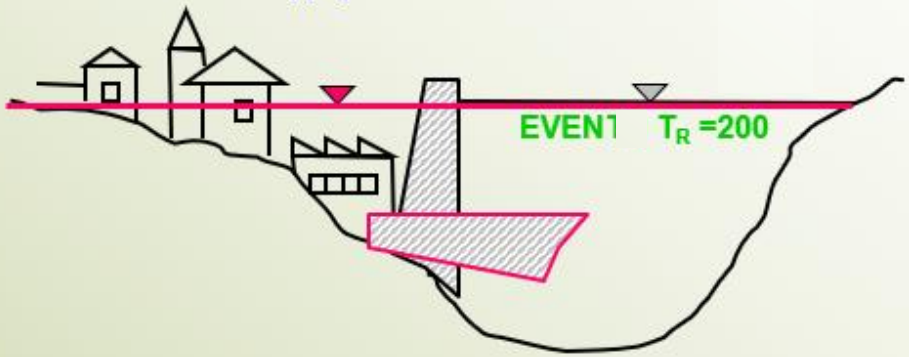
…i.e., **residual risk**….

RISK $R_{200} = 0$

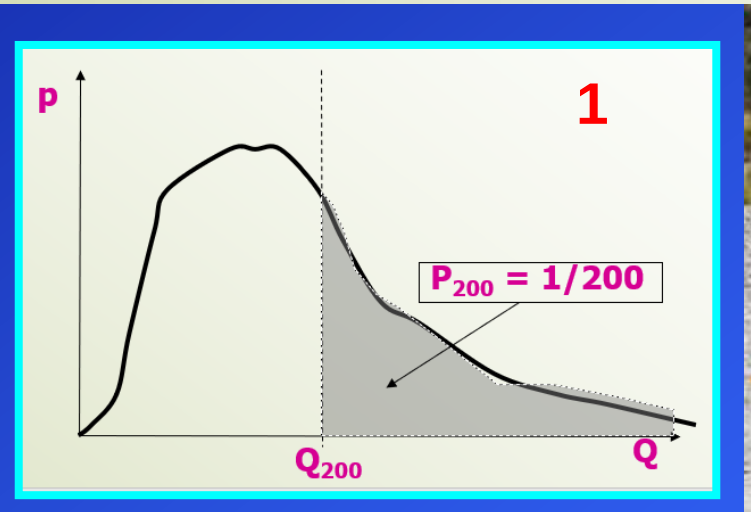
$R_T > 0$!

$R_T(\infty) >> 0$!!

3



⇒ **HIGH fragility**



CC…still same approach ?

You may think that to face CC it is sufficient to increase Q(Tr) for any given Tr and proceed with the usual approach: **«achieve safety through grey measures»….**

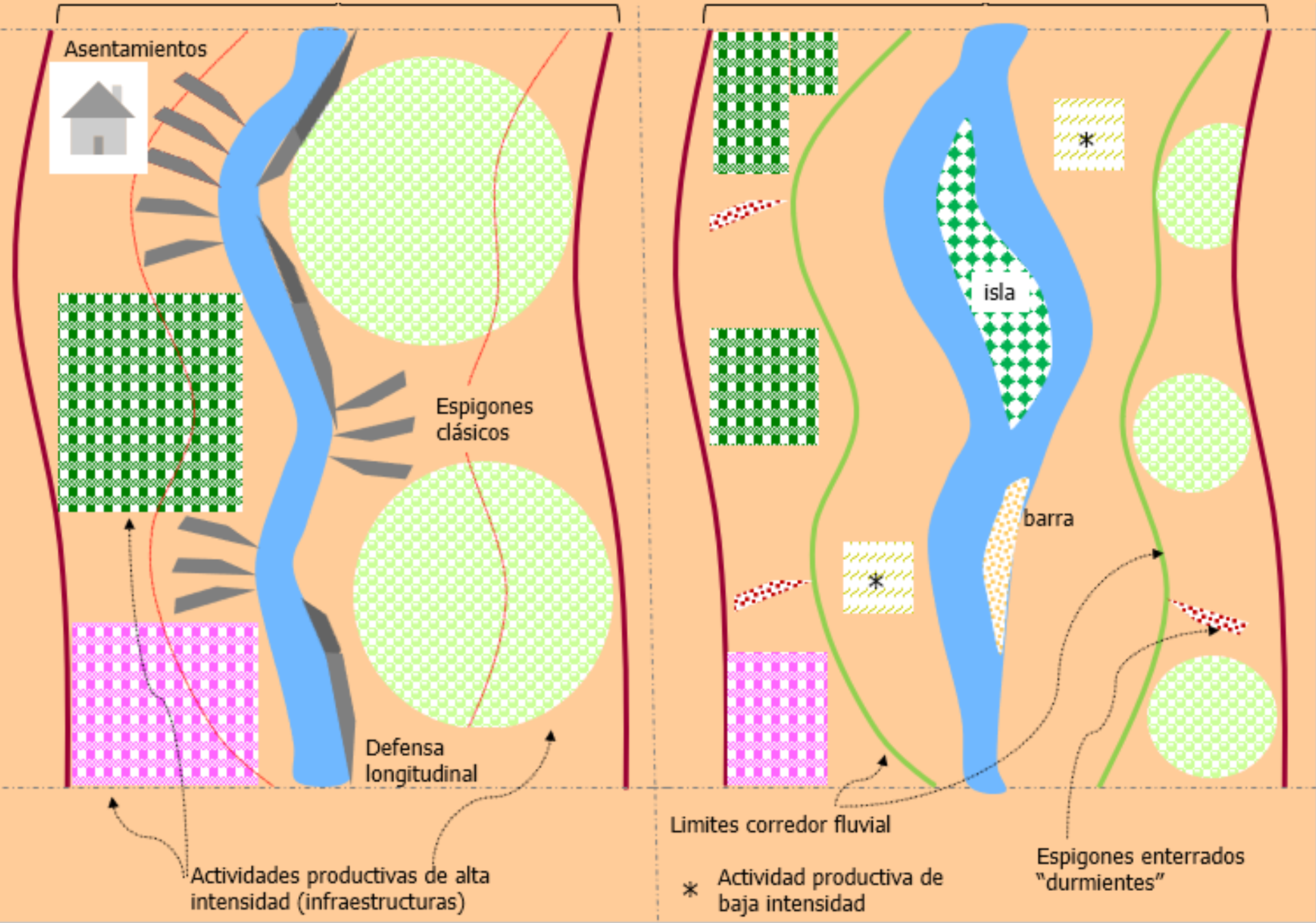
But, sorry,….this is wrong!

- Sea level raise
- Morphological modification of rivers
- Residual Risk and/or Costs (Investment + OMR) to address harsher events simply unbearable
- Enormous uncertainty (T_R) but alteration of climatic mechanisms is guaranteed → new, much more extended phenomena: Un-experienced concomitance of events in the sub basins. Tropical cyclones… in Italy?!

CLIMATE CHANGE

Our LEGACY, if we do not change now

The Fluvial CORRIDOR



OUTSIDE the RIVER CORRIDOR

It is *naïf* to hope that water remains inside the channel…..

it simply will not, and residual risk is very HIGH

middle course of Lambro River (Milano Italy)

….adaptation: towards «**hydro-cities**»

…more than *sponge cities* or *water proofing…*

MILANO (I), METRO5 flooding by Seveso River 2014 (project FLORIMAP; conception and photos: Daniele Bignami, Fondazione Politecnico MI)

→ *prepare preferential waterways with least assets exposed: eliminate basements and low passages*

→ *prepare escape ways*

→ *modify or even remove/reconstruct buildings suitably*

....adaptation: towards «**hydro-cities**»

Sono avveniristici, tecnologici, smart, ma soprattutto bizzarri (e anche brillanti) i palazzi immaginati dagli architetti per le città del domani.
Una giuria internazionale di esperti (tra loro anche Massimiliano Fuksas e Benedetta Tagliabue) ha esaminato 408 progetti arrivati da tutti e sette i continenti per il concorso «Skyscraper Competition», il premio istituito dal 2006 dalla rivista americana eVolo.
Gli architetti si sono focalizzati sull'uso innovativo dei materiali, sulle tecnologie, sull'estetica, ma soprattutto su quei problemi che molte metropoli dovranno affrontare in un futuro non così lontano: il sovraffollamento, il riscaldamento globale, i disastri ambientali.
Al di là del fatto che questi colossi probabilmente non vedranno mai la luce, resta comunque uno spettacolo scorrere le immagini dei progetti premiati.
La «Bio-Piramide» (nella foto) è stata concepita come una biosfera tra il deserto del Sahara e la città del Cairo.
Immaginata da un team di architetti statunitensi ha avuto una menzione d'onore
(a cura di Elmar Burchia. Foto eVolo)

Key messages:

- *start from LOVE ♥ with no shame*
  Solve the weaknesses of the ecosystem assessment WFD-scheme (role of HyMo, OOAO criterion); merge "peculiarity"
- *Understand the geomorphic behavior of rivers at the basis*
- *Recognize the M Obj nature of decision problems; merge scientific & participatory components; measure key objectives C, R_T, N , … via Value Functions; adopt a really integrated view of actions: water supply, flood control, nature conservation, energy*
- *RISK: Abandon the "SAFETY" chimera, and foster a cultural revolution from engineering to an NBS paradigm, exploring integrated ALTs of fluvial corridor, land use & hydro-cities*
- *Bravely consider possible future hydrology → choose solutions which be robust and flexible (no-regret criterion)*
- *Start now: planning and implementation need a lot of time!*

Hydro-Morphological RISK under CC:
an unexpected powerful ally

RISK ←→

nature based solutions

←→ **conservation & restoration**

RISK MANAGEMENT UNDER CLIMATE CHANGE CAN SERIOUSLY SUPPORT NATURE CONSERVATION & RIVER RESTORATION

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20 April 2023

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water

MDPI

Concept Paper

Making room for our forthcoming rivers

Andrea G.C. Nardini [1]

Photo: Burtynsky

River Management & Restoration: What River Do We Wish for

by Andrea Gianni Cristoforo Nardini [1,*] and Giulio Conte [2]

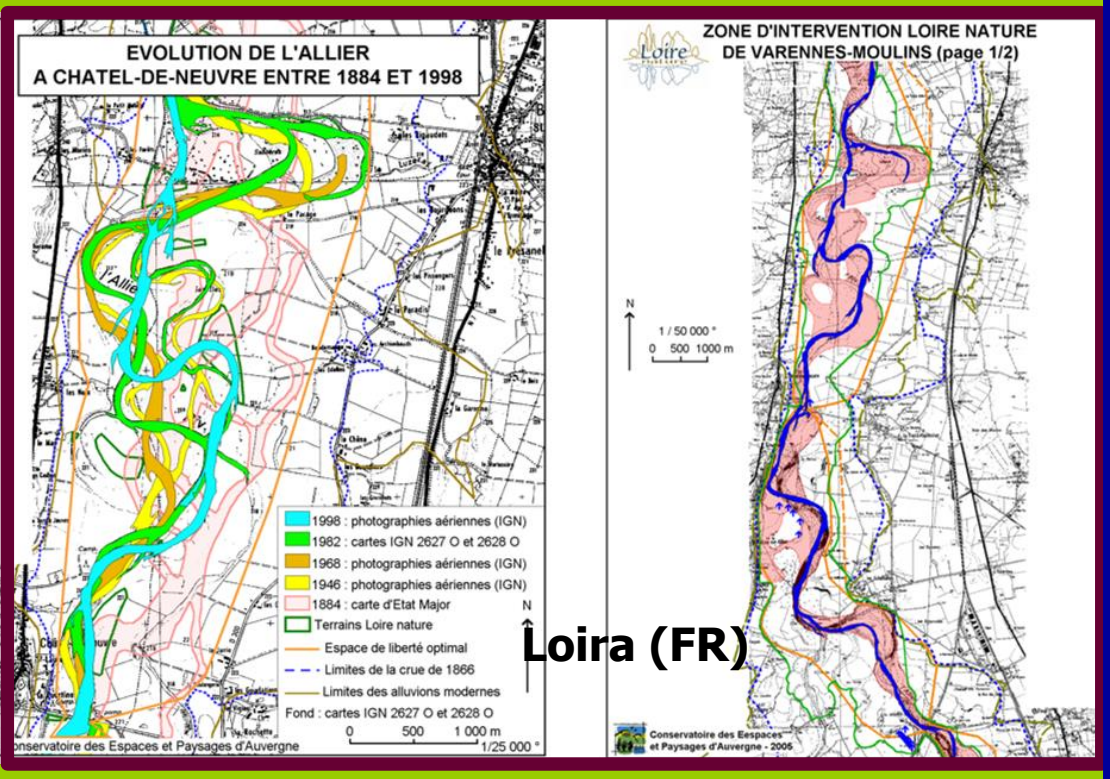
[1] Fundación CREACUA, Calle 1A n.1-109, Riohacha, La Guajira 440001, Colombia

[2] IRIDRA SRL, Via La Marmora 51, 50121 Florence, Italy

* Author to whom correspondence should be addressed.

Water **2021**, *13*(10), 1336; **https://doi.org/10.3390/w13101336**

EXPERIENCES ? Yes, several!



Loira (FR)