Andrea Nardini **CIRF**

Hydro-geological risk

Pollution

Loss of biodiversity, and naturality

Competition on WR use: MIFR

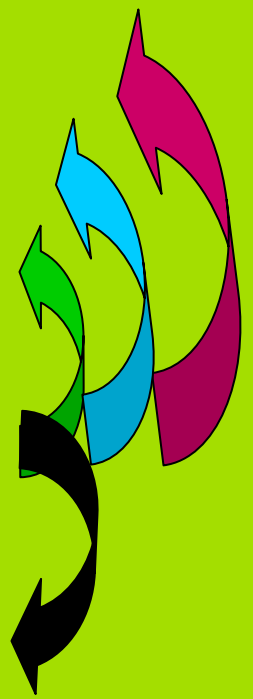
Wild urbanization

Loss of geomorpho equilibrium

RIVER RESTORATION: objective and means

RR

- more safety
- allow anthropic activities
- satisfy recreation and fruition
- improve rivers (existence value)
- reduce costs (investm.&manag.)



R. RESTORATION:
a complex universe

- **preservation**
- **conservation**
- **renaturation**
- **rehabilitation**
- **remediation**
- **reclamation**
- **enhancement**
- **creation**

"Restoration"

"Riqualificazione"

River Restoration Centre –RRC (UK)
Website:
www.therrc.co.uk

Romanian Centre for River Restoration –RCRR
Website: www.rcrr.org

Centro Italiano per la Riqualificazione Fluviale
Italian River Restoration Centre
Website: www.cirf.org

.....

European Centre for River Restoration
Website: www.ecrr.org

ECRR

European Centre for River Restoration

State of the art

ECRR secretariat, e-mail: ecrr@ecrr.org, www.ecrr.org

Website: **www.ecrr.org**

AIMS OF ECRR

- support the development of river restoration
- Make RR an integral part of sustainable water management (IWRM) and WFD
- Connect people and organisations working on river restoration.

Centro Italiano per la Riqualificazione Fluviale

Italian River Restoration Centre

Viale Garibaldi 44/a 30173 – MESTRE (VE) - I

Tel +39-041-615410

"STRARIFLU": a RIVER RESTORATION STRATEGY for Regione Lombardia (I)

Website: www.cirf.org

Email: direttore.tecnico@cirf.org; info@cirf.org

INTEGRATED CHARACTERIZATION of RIVERS' STATUS:

Three problems raisen by WFD

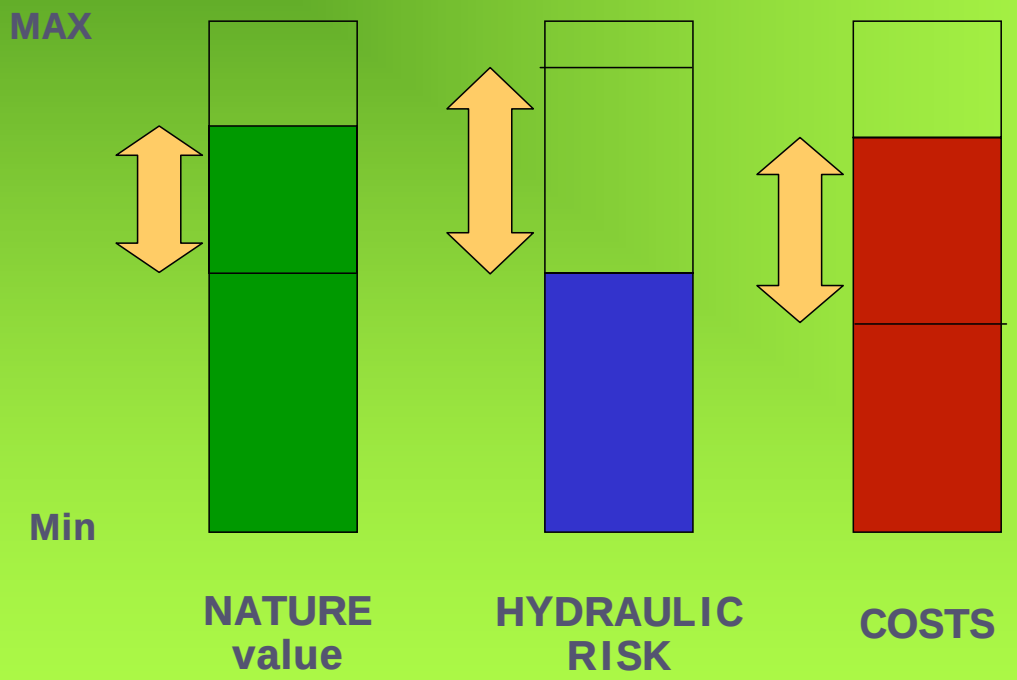
1) Specify "parameters" ***(attributes)*** to describe the status (physico-chemical, biological, hydro-morphological) and **indicators** to measure them

2) Define the ***reference conditions (status)*** for each *typology* in a given *eco-zone*

3) Establish which **threshold value** of such indicators determines the change of *quality class* (from *scarce* to *exellent*), ensuring the international comparability (***inter-calibration***)

...but charaterizing is not enough...

because RR is a MULTIOBJECTIVE problem



→ need to measure the "*river value*"

MEASURING "river value"

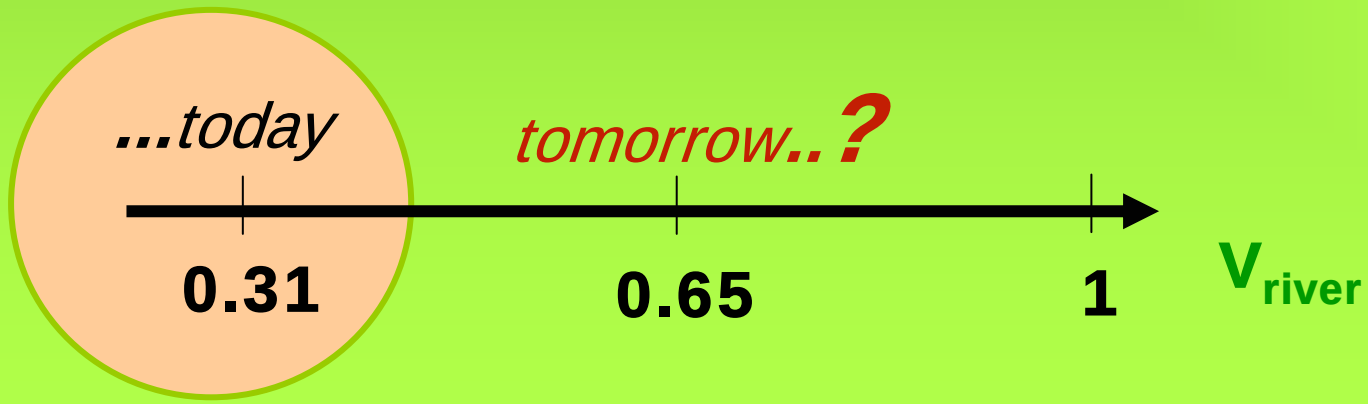
Because:

of its *existence and philanthropic value* + *indirect use* (environmental services)

Through:

-Economic valuation techniques (contingent valuation; substitution cost...)

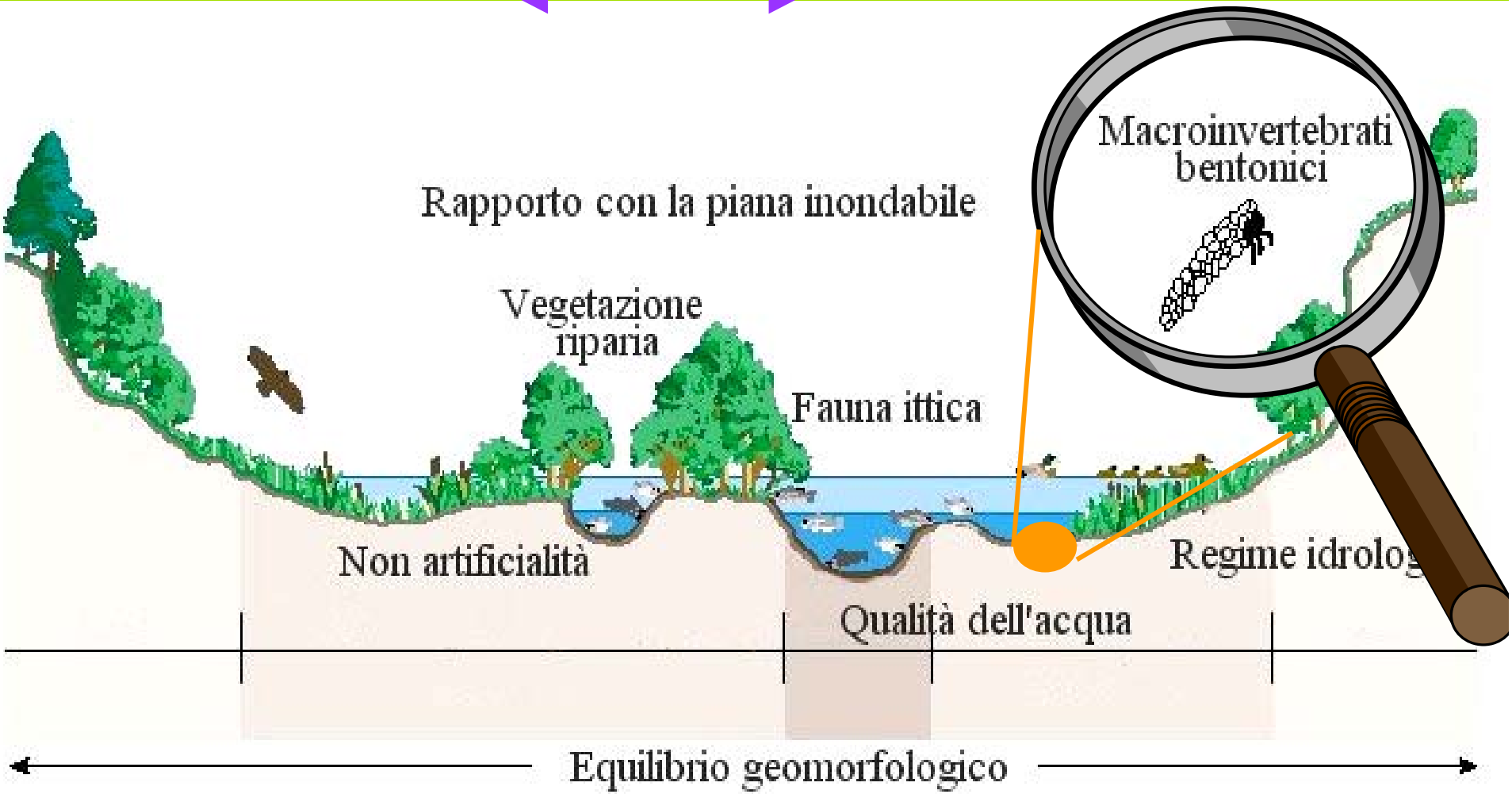
- or simply an **arbitrary scale with relative meaning**:



CHARACTERIZATION:

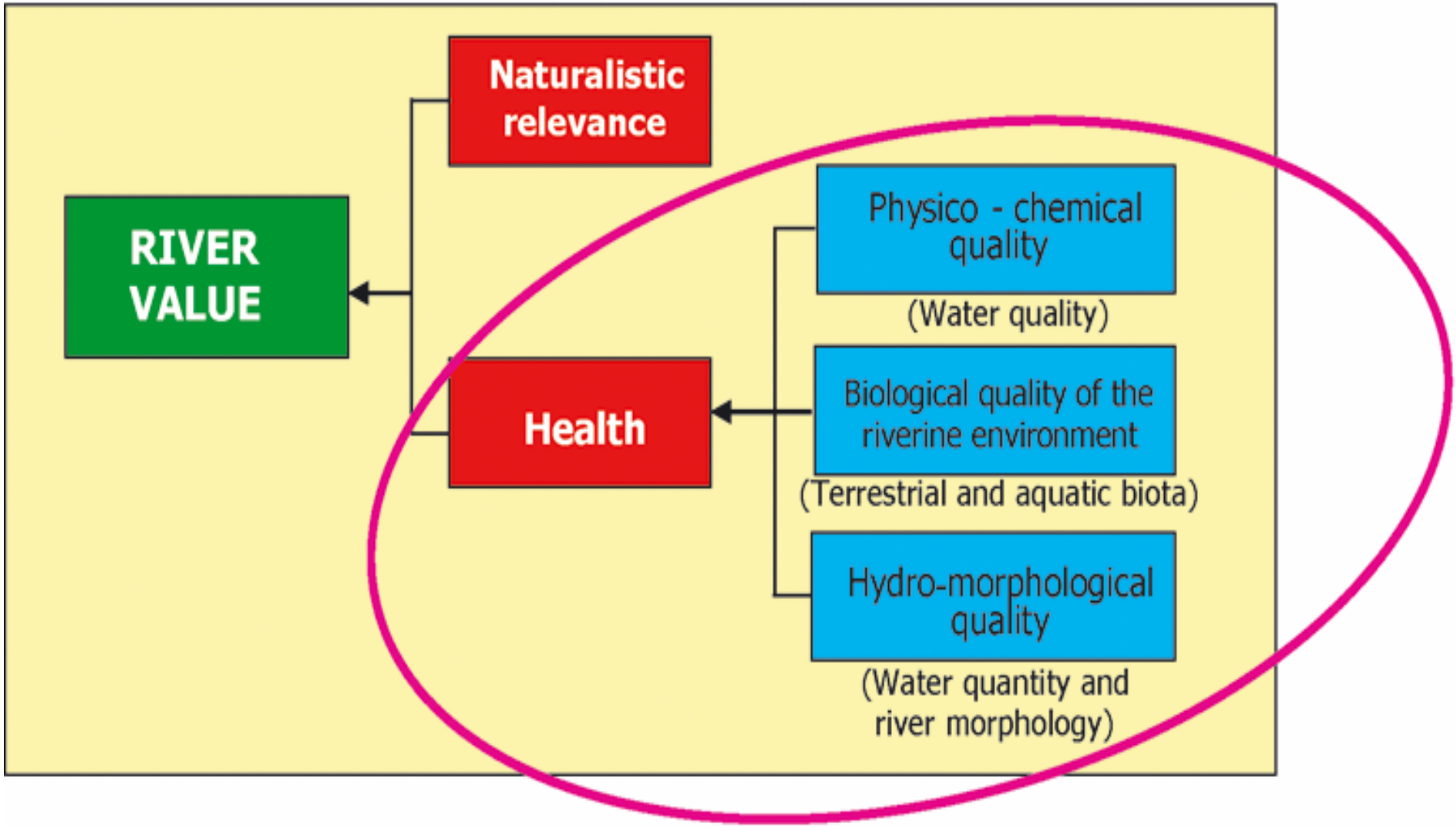
Which ATTRIBUTES and INDICATORS?

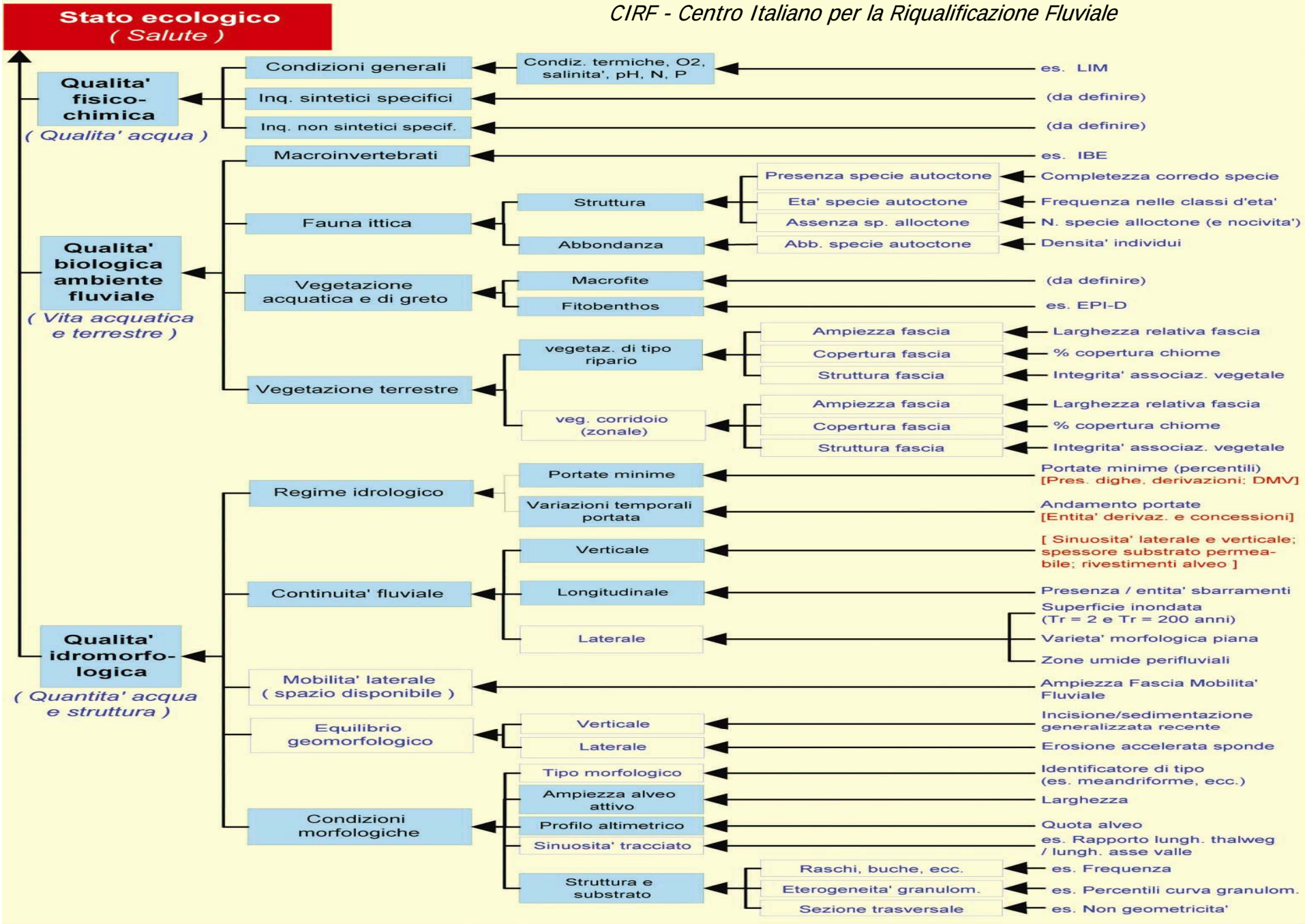
Current status ⟷ ***Reference status***



CHARACTERIZATION:

Which ATTRIBUTES and INDICATORS?





Legenda: Elementi previsti dalla Dir. 2000/60/CE | Specifiche proposte dal CIRF | indicatori [indiretti], alternativi ai diretti

CHARACTERIZATION:

Which ATTRIBUTES and INDICATORS?

Remarks:

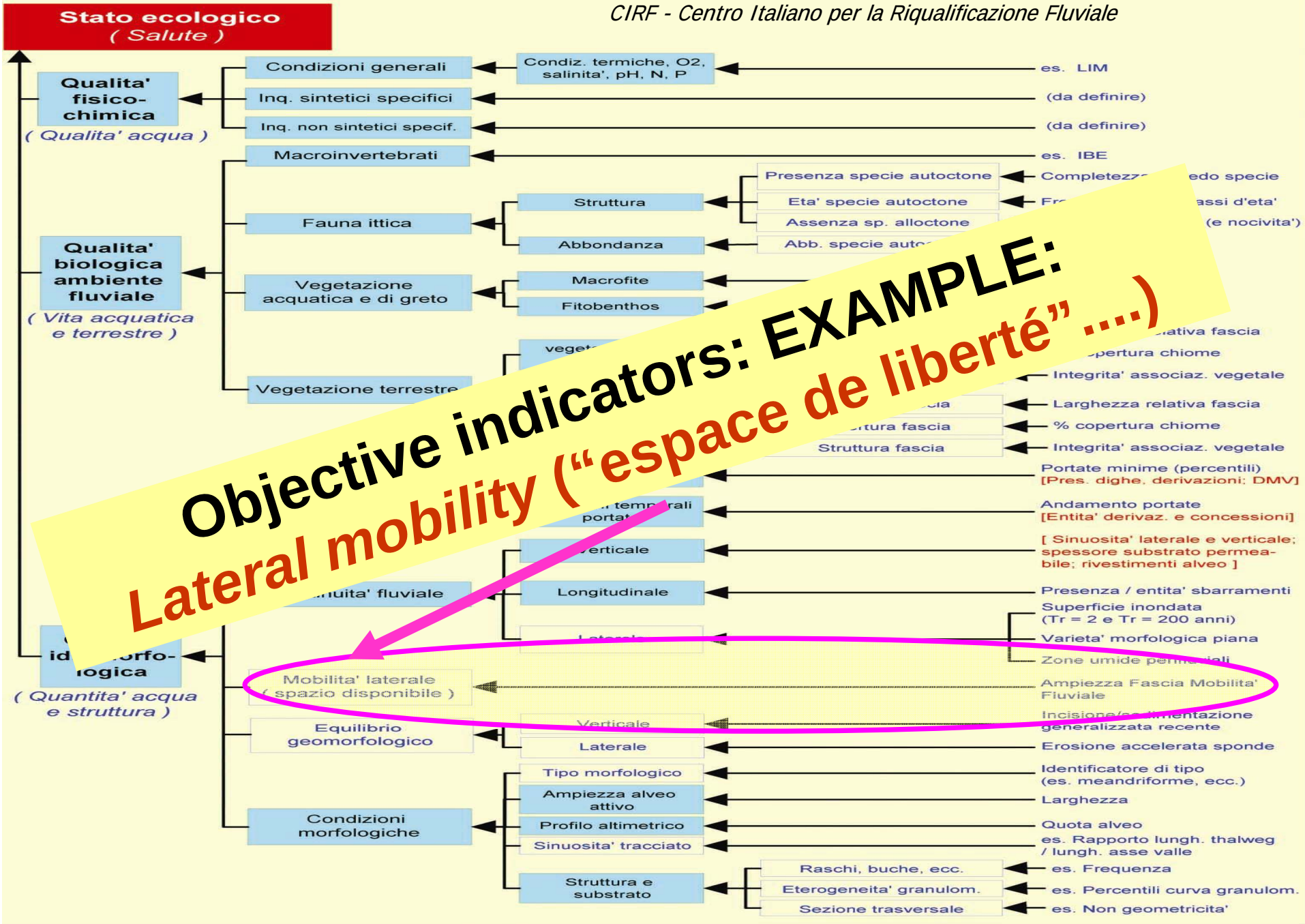
- As far as possible: use objective indicators, not subjective scoring methods (es. *biotic naturality* : score 1÷10 ; n.autochthonous/n.total)

- Need for flexibility according to : scale, data availability (resources to get them), problem faced

- Conceptually impossible to use “standard” indicators and, in general, neither those from the literature (...)

WHY do not use literature INDICES?

Criteria Experiences	Purpose	Reference conditions	Complies with WFD parameters	Suitable for large-scale, frequent updating	Objective indicators
SEQ_s (1)	Evaluate the state of degradation, (from which quality objectives are defined and planned)	yes	Yes. SEQ (Quality Evaluation System): SEQ_{eau} (for water quality indicators), SEQ_{bio} (for biological indicators), and SEQ_{phy} (for physical indicators)	yes. Cartographic analysis done at a scale of 1:1000000; system based on periodic surveys.	Partially
Aktion Blau (2)	Characterize and assess the physical structure of rivers	yes	Partially (does not include biological and physico-chemical attributes)	Hard (is born to be applied at a very detailed scale; requires on-site operators)	Yes
RHS (3)	Characterize and assess the physical structure of rivers	yes	Partially (does not include biological and physico-chemical attributes)	Hard (is born to be applied at a very detailed scale; requires on-site operators)	No (uses a subjective scoring system)
IFF (4)	Assess fluvial funcionality	no	Partially (does not include physico-chemical attributes, and only part of the biological and hydro-morphological ones are tackled)	Hard (is born to be applied at a very detailed scale; requires on-site operators)	No (uses a subjective scoring system)
FLEA	Evaluate the ecological status of rivers	yes	yes	yes (can be applied at both regional or local scale)	Yes (although data scarcity may be substituted by judgment)



Legenda: Elementi previsti dalla Dir. 2000/60/CE | Specifiche proposte dal CIRF | indicatori [indiretti], alternativi ai diretti

EXAMPLE:

Lateral mobility -Mobility Strip (MS)

Reference status

$A_{fm}(0)$

Current status

$A_{fm}(t)$

$r_{fm} = \min[1, A_{fm}(t)/A_{fm}(0)]$

$r_{fm} = 0$ there is no MS

$r_{fm} = 1$ MS is as it was (or larger)

$r_{fm} = 0,5$ only 50% left

CHARACTERIZATION:

building any INDEX

Two Problems:

1) MEASURE the DISTANCE between current and reference status → *closeness-index* (for each indicator)

2) AGGREGATION:

- amongst indicators (at different levels)

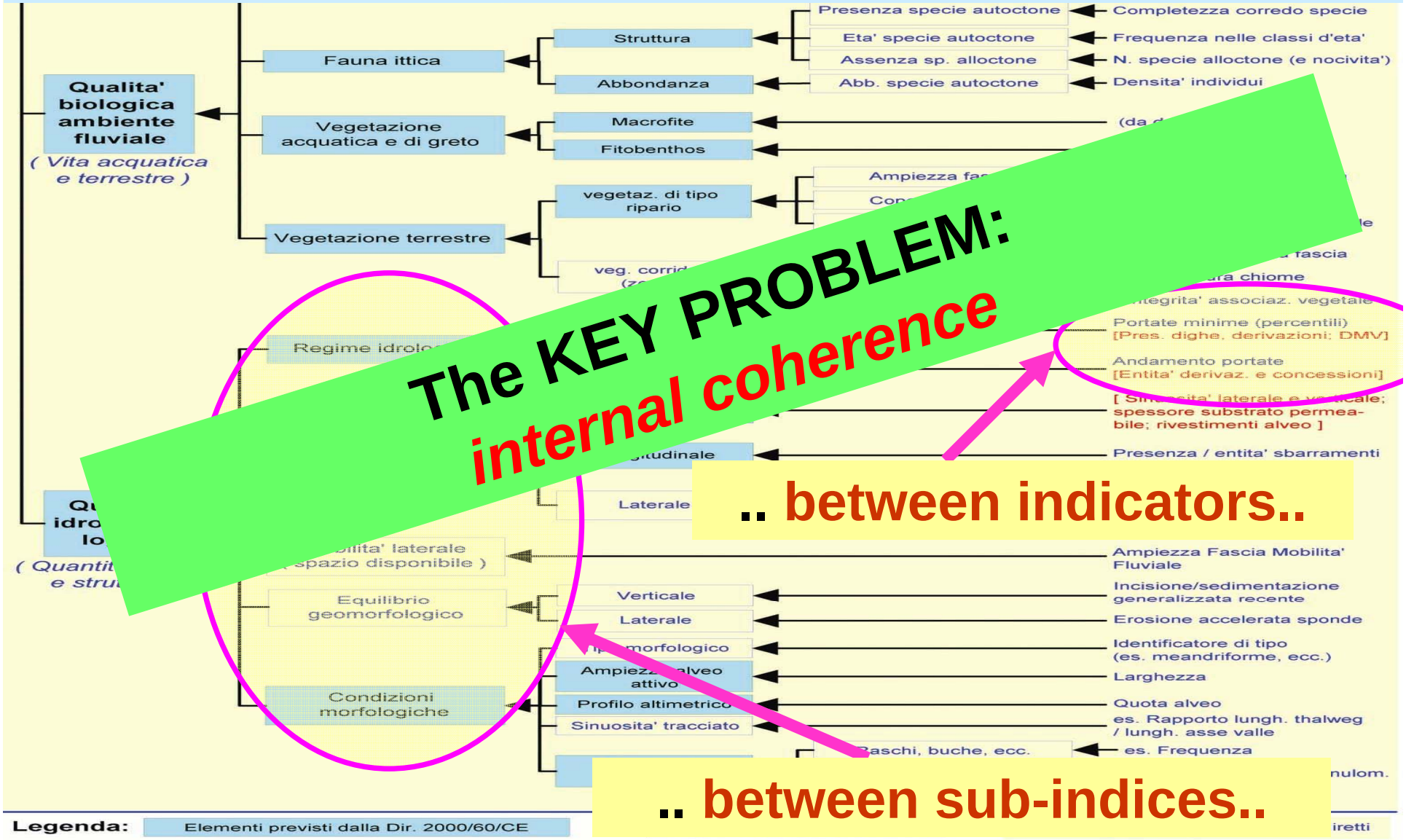
- in the space: from discrete stretches of each indicator to common reaches (intersection); from reaches to ...river

- in the time: istantaneous situation, average, worst, ...

NOTICE: both include subjective (experts) value – judgments , even if we count on millions of data!

CHARACTERIZATION:

Building any INDEX: aggregation



The KEY PROBLEM:

internal coherence

.. between indicators..

.. between sub-indices..

CHARACTERIZATION:

building any INDEX:
INTERNAL COHERENCE and VF

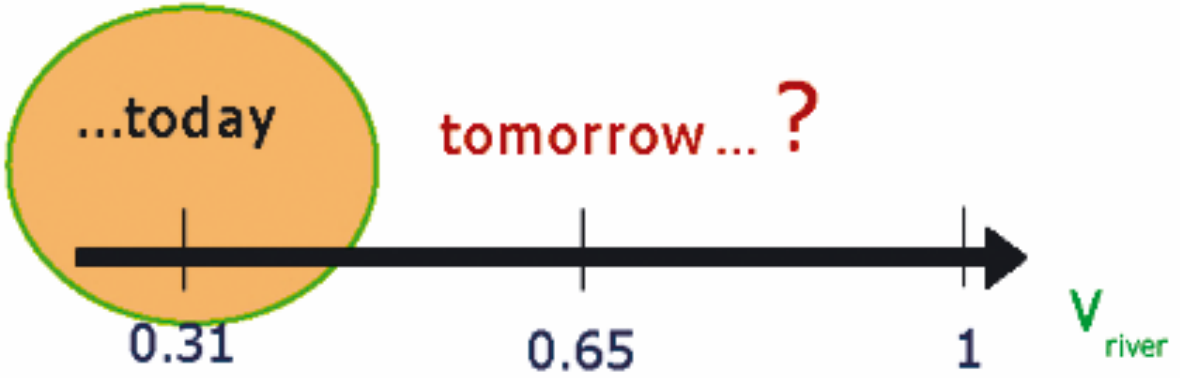
- To *situation* $X=(d_1', d_2', d_3')$ must correspond a number $I(d_1', d_2', d_3')$
- $I(A)=I(B)$ must imply that situations A and B are 'to us' equivalent (I cannot prefer one to the other); if A is preferred to B, then: $I(A)>I(B)$; and viceversa
- Same increments of the index must add same additional satisfaction

$\Rightarrow$ any Index must be a ***Value Function*** (Keeney e Raiffa, 1976)

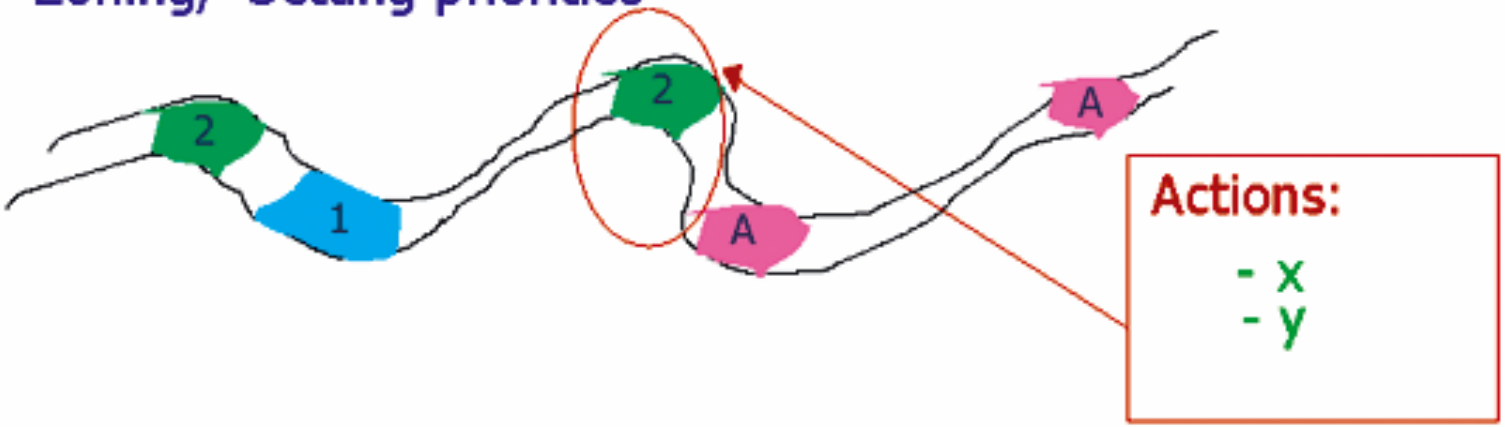
STRARIFLU (STRAtegia di RIqualificazione FLUviale in Lombardia):

Regional strategy for RR in Lombardia-I

- Assessment of the river value

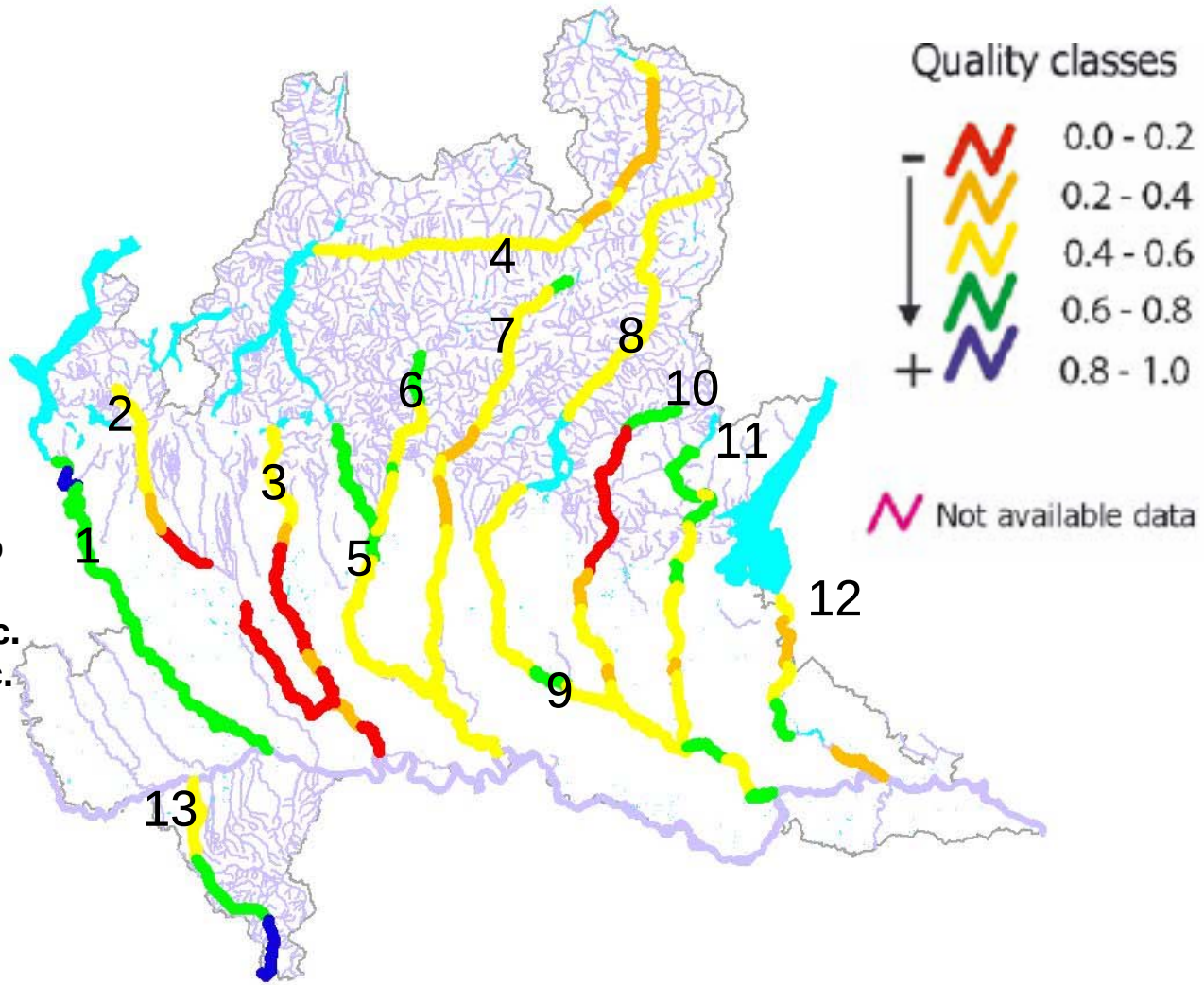


- Zoning/ Setting priorities



STRARIFLU

The RIVER VALUE map



1. **Ticino**
2. **Olona-Lambro**
3. **Lambro**
4. **Adda sopra lac.**
5. **Adda sotto lac.**
6. **Brembo**
7. **Serio**
8. **Oglio Nord**
9. **Oglio Sud**
10. **Mella**
11. **Chiese**
12. **Mincio**
13. **Staffora**

STRARIFLU: using HEALTH-gaps to identify WHAT to DO (ACTIONS)

HEALTH-GAP ($\Delta H_i / \Delta H_{max}$ %)	ATTRIBUTES	KEY ACTION LINES	LOCATION
34%	Vegetation	- Incentives for riparian strips restoration - Plantation of riparian woods and their management	river basin Local, corridor
32%	Hydrological regime	- Reservoir regulation - Demand-side management - Re-allocate water abstraction rights	river basin river corridor
17%	Fishes	- Management of fisheries - Controlling sport fishing	river corridor, basin
11%	Water quality	- Woody buffer strips - Creation of outstream wetland...	river basin, river corridor
10%	Lateral mobility	- Banks removal - Avoid new protection from floods of low value areas - Incentive to extend river floodplain	local river corridor, basin
7%	Geomorphologic equilibrium	- re-introduce sediments from reservoirs - abate river bank defences	river basin local
0%	Macroinvertebr.		

STRARIFLU: using the index for defining ZONING: WHERE doing WHAT

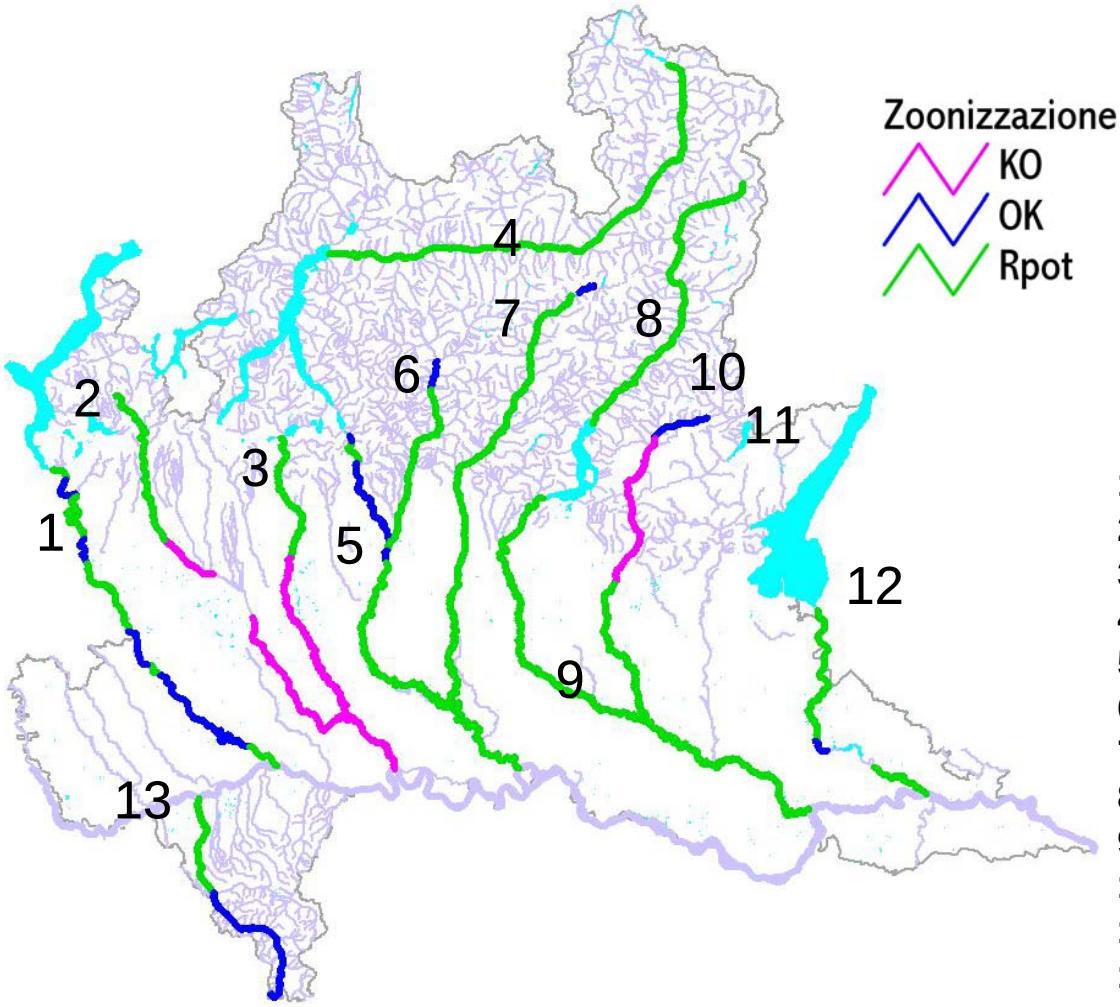
- **reaches "OK":** where *Value* or *Health* pass a threshold ⇒ **must be preserved and / or conserved**

- **reaches KO:** where water quality is unacceptable and/or there is heavy geomorphological instability ⇒ **need an action "now"**

- **reaches R-pot :** all others⇒ **potentially to be restored because one or more "health-gaps"**

STRARIFLU: using the index for

defining ZONING: WHERE doing WHAT



1. **Ticino**
2. **Olona-Lambro M.**
3. **Lambro**
4. **Adda sopra lac.**
5. **Adda sotto lac.**
6. **Brembo**
7. **Serio**
8. **Oglio Nord**
9. **Oglio Sud**
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11. **Chiese**
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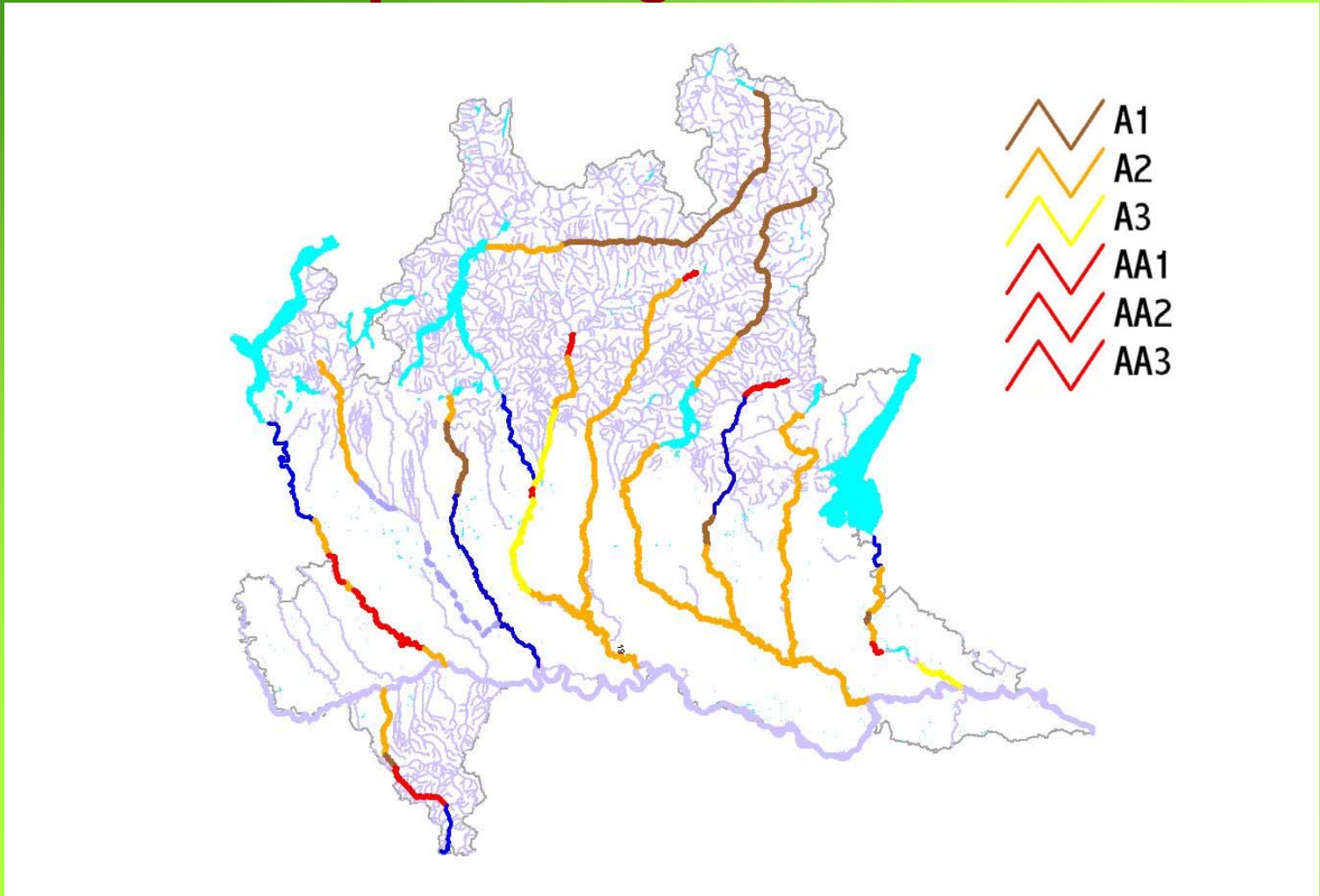
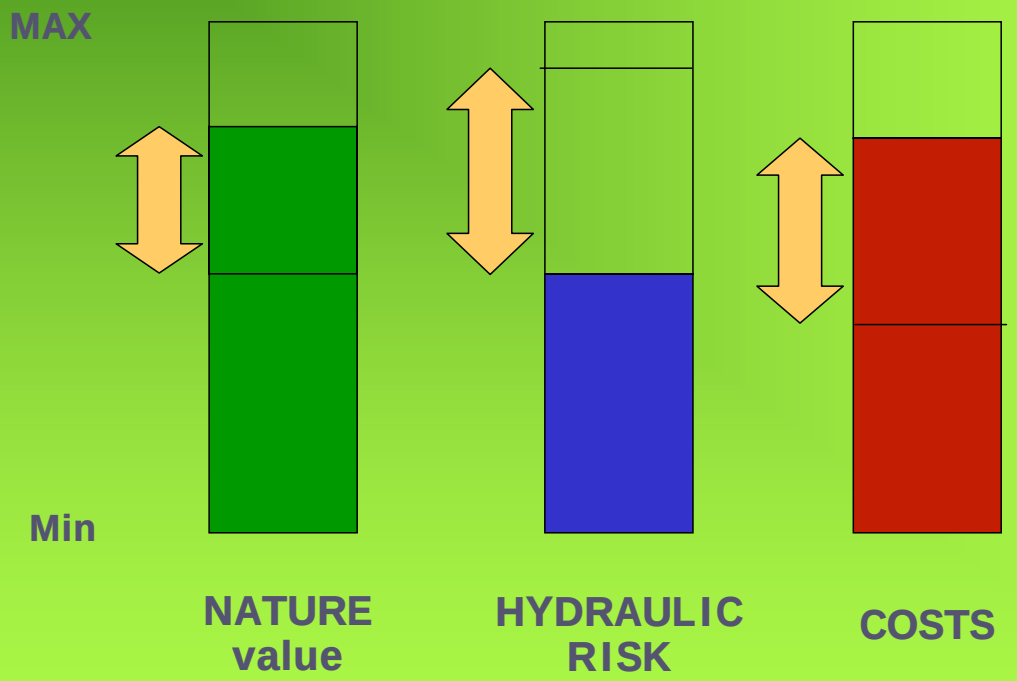
STRARIFLU: using the index for identifying THREATS due to incoherence of planning instruments



...after a “plan-alternative” is defined...

need for a MULTICRITERIA evaluation



→ possibility to negotiate a “*trade-off*”
(and to define HMWB)

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THANK YOU, MERCI, GRAZIE, GRACIAS, SHUKRAN

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