CC WARE: Mitigating Vulnerability of Water Resources under Climate Change

(Focusing on Drinking Water)

http://www.ccware.eu/

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Three main objectives

1. Characterization and mapping of vulnerability
2. Management options for mitigating vulnerability
3. Development of transnational strategy for national/regional Action Plans

Vulnerability is defined as "the degree which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes" (IPCC, 2001)

1. Characterization and mapping of vulnerability

Drinking Water Vulnerability (called further vulnerability) under climate change (CC) is **higher** if the three **main direct indicators** driven by CC:

- Water quantity (supply) is lower
- Water quality is worse
- Socio-economic conditions are weak

To characterize vulnerability quantitatively an **index** is sought that expresses the above three main indicators in an **integrated** way.

Three possibilities to represent vulnerability:

Direct use of the three **main direct indicators**

Forming **indirect indicators** that reflect the key factors influencing the direct indicators.

Combination

Direct use of main indicators driven by CC would be preferable.

However, in the majority of cases such direct indicators are **unavailable**, thus vulnerability is to be characterized using indirect indicators.

Background of water resources vulnerability assessment

Lots of information (e.g. Nachtnebel, Bogardi, Bleed, 1990; Kulshreshtha, 1993; Climate Change and Water Vulnerability, 2009; Gain et al., 2012).
Main message: necessary to represent

physical impacts that will be brought about by climate change
hydrological/geo-morphological
socio-economic aspects

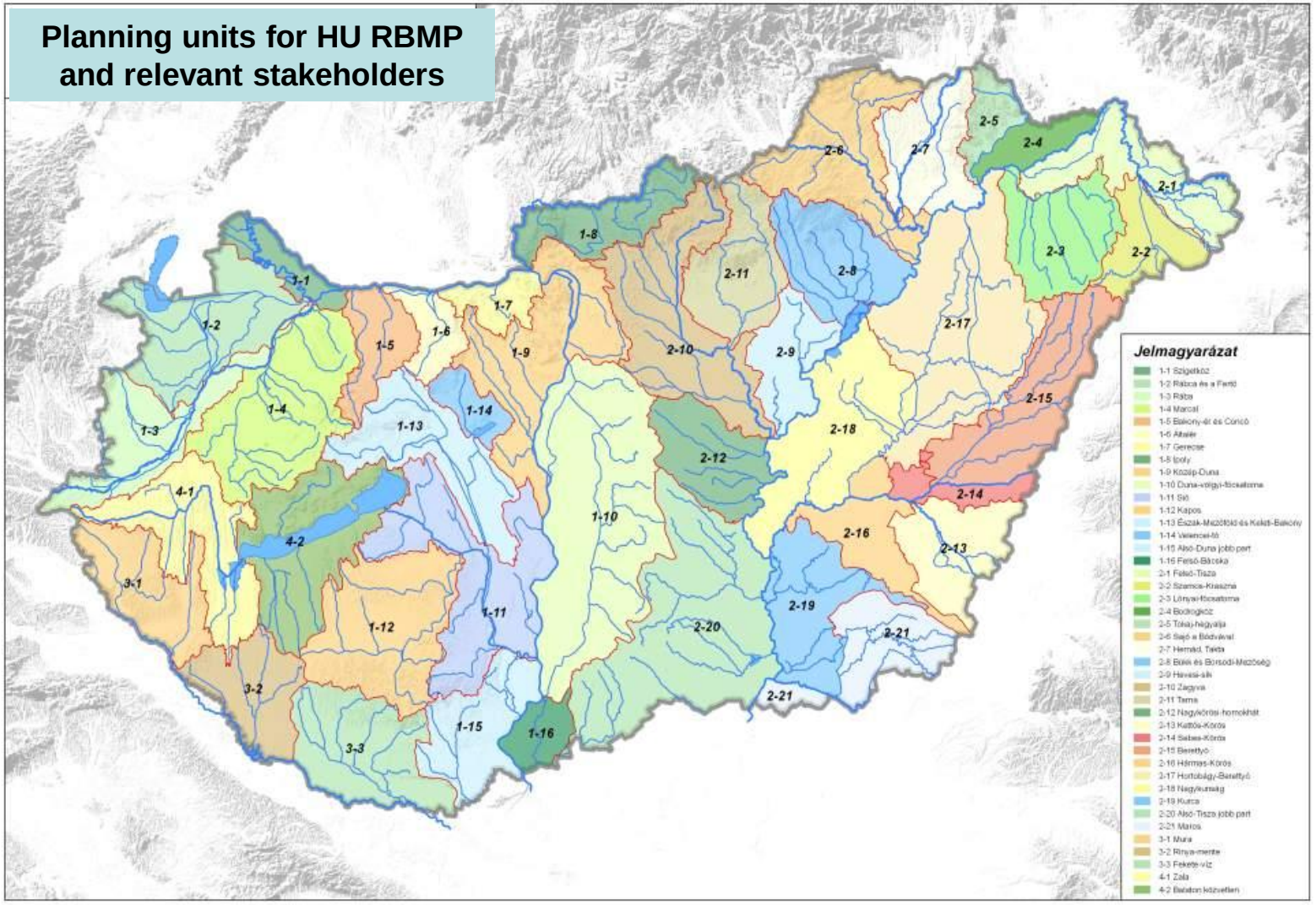
An approach which **combines** these different components is needed.

Choose spatial scale

Two key issues:
1. Different **disciplines**
2. Different **spatial and time scales**, from the grid of hundreds of kilometers across global climate models, to the community scales of human coping and adaptation potential.

Between these two scales an **intermediate scale** of application – a scale between the national and community levels – could be the best which is practical for application over wide areas.

Planning units for HU RBMP and relevant stakeholders



Define type of drinking water sources

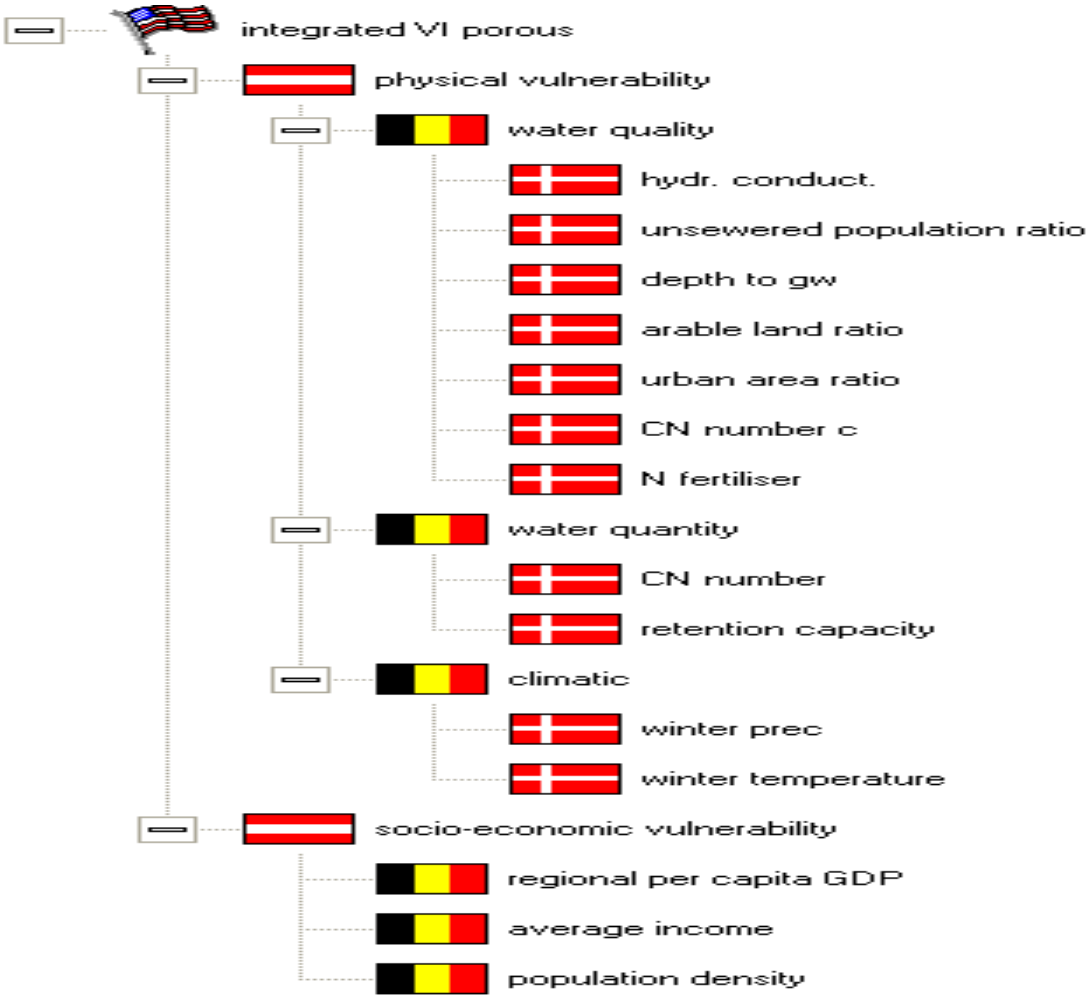
- Surface water
- Porous media
- Karstic aquifer
- Bank filtered

Construct structure of indicators

There will be four branches of the structure of indicators:

- Integrated vulnerability index
- Physical and Socio-economic vulnerability indices
- Climatic, hydrological-geographical and socio-economic composite indices both for water quantity and water quality
- Basic indicators for the climatic, hydrological-geographical and socio-economic groups.

Structure of indirect indicators (porous aquifer)



Structure of indirect indicators (surface water source)

Integrated surface water VI

- Physical vulnerability
  - Climatic
    - Prec. change
    - Temp change
  - Water quantity
    - Drainage area
    - CN number
    - Drainage density
  - Water quality
    - Erodibility
    - Sediment Delivery Ratio
    - Nutrient
    - Arable land ratio
    - Ratio NP and PP
- Socio-economic vulnerability
  - Population density
  - Regional per capita GDP
  - Employment ratio

Structure of direct vulnerability indicators

Direct basic indicators **Composite indicators →**

Recharge
……. Groundw. quant.
…….
---------- **Water quantity**

Runoff
……. Surface w. quant.
…….
---------- **Physical Vulnerability**

Nitrate
……. Groundw. quality
…….
---------- **Water quality**

DOI
…….. Surface w. quality
…….

Population dens.
Average income
Reg. per capita GDP

Socio-Economic Vulnerability

Integrated Vulnerability Index

Calculate Vulnerability Indices

Numerous multi-criteria methods are available to develop a composite index from multiple indicators including Multi-Attribute Utility Theory (Canada and Sullivan 1989), ranking methods such as ELECTRE, multi-objective methods such as goal programming (Goicoechea et al., 1982), Compromise Programming (Zeleny 1982), and Composite Programming (Bogardi and Bardossy, 1983).

For the present purpose, Composite programming (CP) is used because of its ability to consider and integrate completely different indicators (e.g. physical vs. socio-economic) into a single analysis

Evaluate Vulnerability Indices

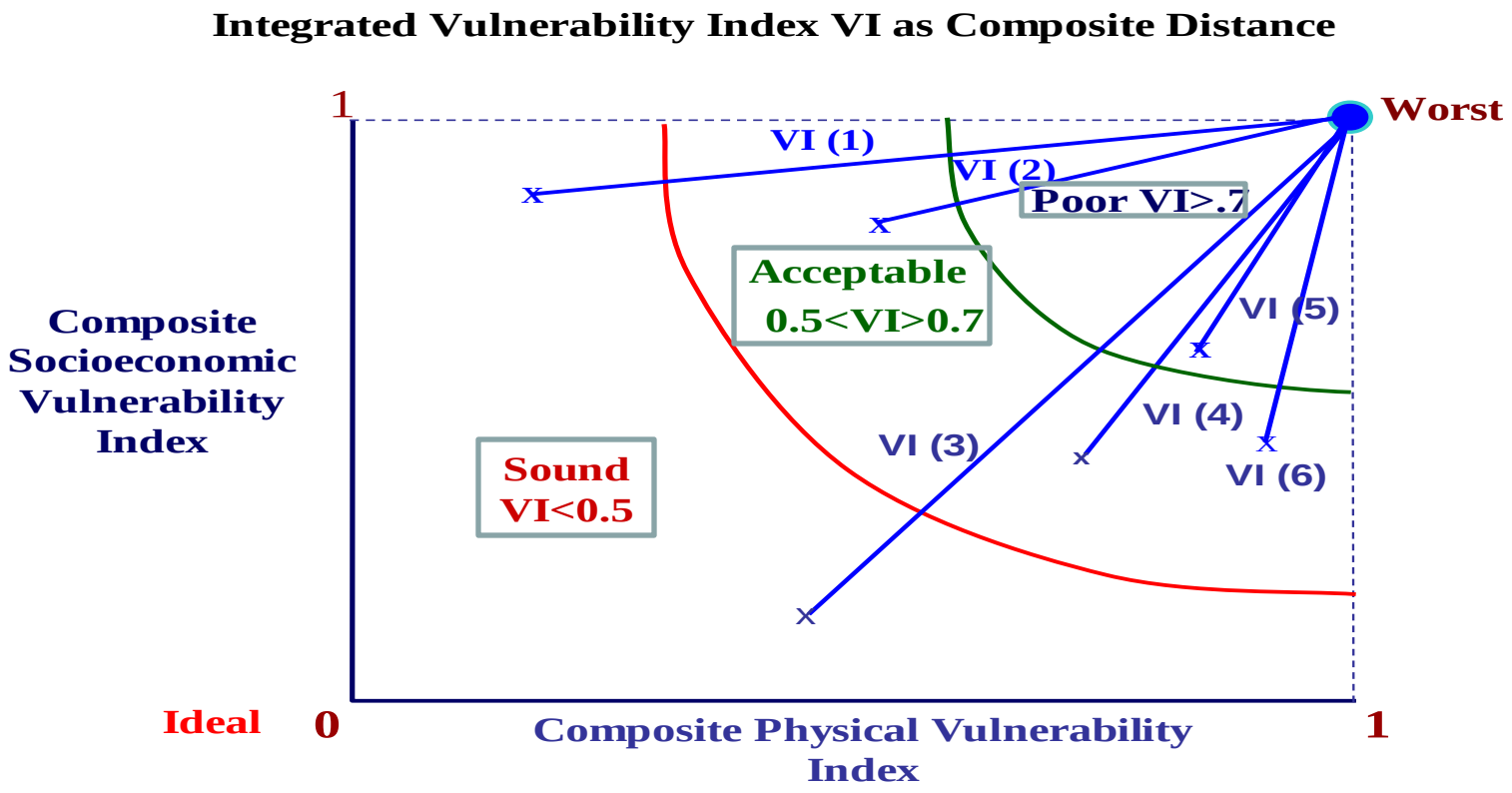
Vulnerability indices are then divided into – say – three groups:

0-0.5 low vulnerability

0.5 – 0.7 medium vulnerability

➢ 0.7 high vulnerability

Integrated Vulnerability Index VI as composite distance for six planning units



2. Management options for mitigating vulnerability

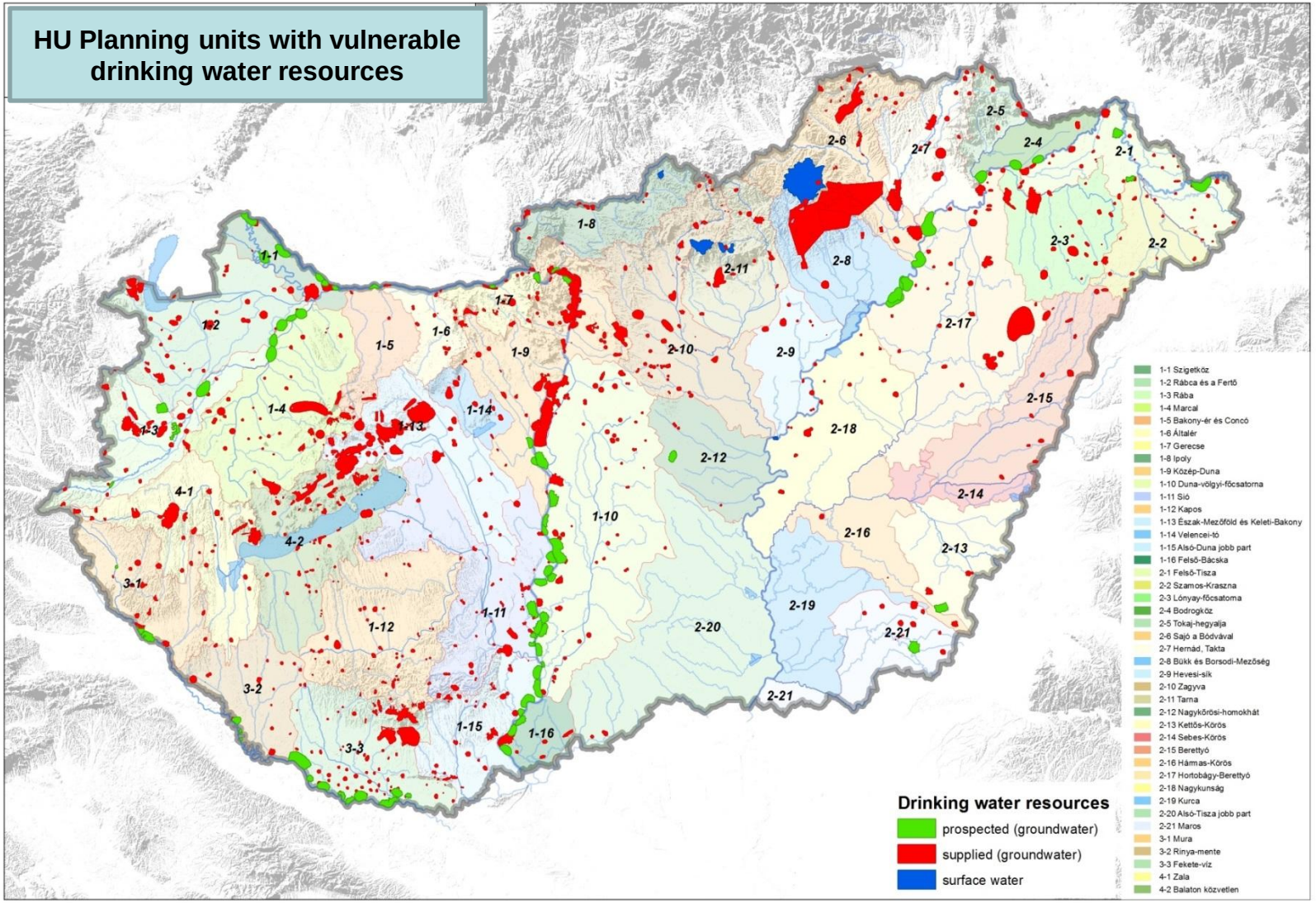
- The concept is
  - to analyse land use regulation in context of a safe drinking water supply
  - to revise different management options of drinking water suppliers
  - to pay special attention to Ecological Services (ES) concerned drinking water supply
  - to estimate potential changes of ES due to climate change (in case of forests, wetlands, floodplains, bank-filtered buffer zone areas, etc.,)
- The output and result is
  - a proposal for improvement of land use regulations of SEE countries
  - to define the role of ES in supply pure drinking water in appropriate quantity in different climate region based on ‚homogenous area'
  - editing of a common catalogue with recommendations based on best practices of water supply management and adaptation to CC via land use and ES

DANUBE REGION strategy Water Quality

DANUBE REGION strategy Environmental Risks

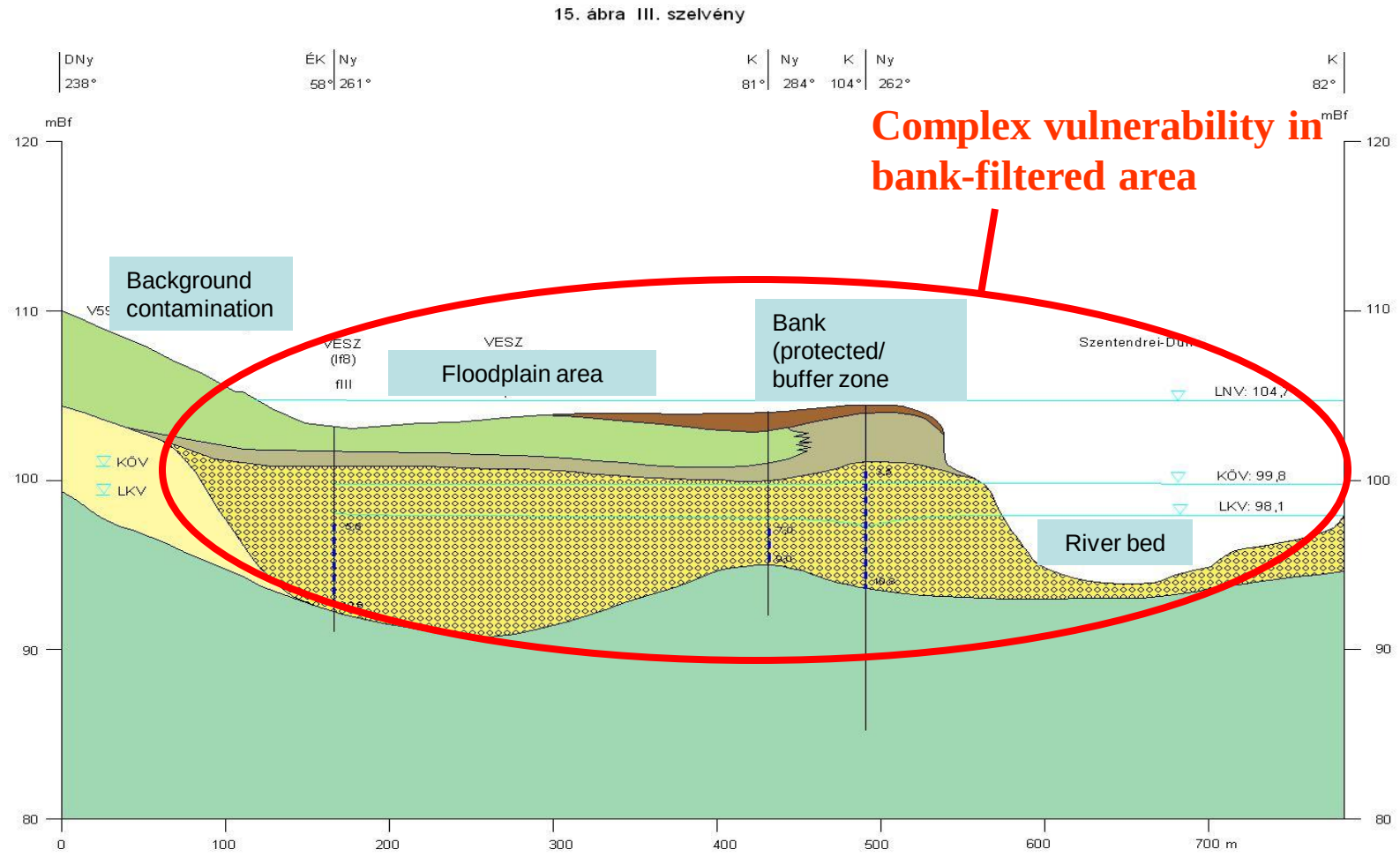
DANUBE REGION strategy Biodiversity

HU Planning units with vulnerable drinking water resources



A good example on ES for drinking WS

By courtesy of Smaragd-GSH Kft.



3. Development of transnational strategy for national/regional Action Plans

- The concept is
  - to comply, apply and transfer the developed and achieved knowledge
  - to fulfil resulting measures in SEE region
  - to strenghten the institutional capacity and human resources at
    - regional
    - national
    - local level

    } for MS and Pre-accession countries of SEE region
  - to support the Danube Region Strategy (to establish bufferstrips…, to promote measures to limit water abstraction, and … safeguarding of drinking water supply according to Water Quality Actions)
  - to support
    - the EU 2020 Strategy,
    - the EU WFD,
    - the Water Blueprint
    - the EC Communication on Water Scarcity and Droughts,
    - the EC White Paper on Adaptation to CC

Expected outputs in CC-WARE (based on antecedents)

- **Integrated transnational strategy (ITS**) for mitigating the vulnerability of water resources with special regard to drinking water supply in SEE (a not legally binding Strategic Paper for stakeholders' debate as Green Paper)
  - ✓ **Integrated** – quality & quantity
    - surface & groundwater
    - water supply & ES
  - ✓ **Transnational** - „more water „ SEE countries due to CC
    - „less water" SEE countries due to CC
  - ✓ **Strategy** - policy management to mitigation of harmful CC effects
- **Framework** for facilitating the implementation, via development of **National / Regional Action Plans** (Guidance)
  - ✓ Collecting of already existing national/regional programmes/projects as **good practices**
  - ✓ Collecting of national plans on vulnerability management **(if any)**
  - ✓ **Selection outputs** from above mentioned docs for harmonized drafting of National/Regional Action Plans

Dissemination of results

- Knowledge transfer to
  - ✓ All SEE countries (highly focusing on pre-accession ones)
  - ✓ Preparatory work for consultation
  - ✓ Workshops planning (how many, where and when ?)
  - ✓ Publications (format, content, peridicity)

- Knowledge Transfer Task Group
  - ✓ Stakeholder seeking
  - ✓ Workshops
  - ✓ Consultations

DANUBE REGION strategy Water Quality

DANUBE REGION strategy Environmental Risks

DANUBE REGION strategy Biodiversity

THANK YOU!

MAGYARORSZÁG MEGÚJUL

ÚJ SZÉCHENYI TERV