SWIM and Horizon 2020 Support Mechanism

Working for a Sustainable Mediterranean, Caring for our Future

Drought Risk Profile

Presented by:
Mr. Floris VERHAGEN, Senior hydrogeologist

Mainstreaming Drought Risk Management
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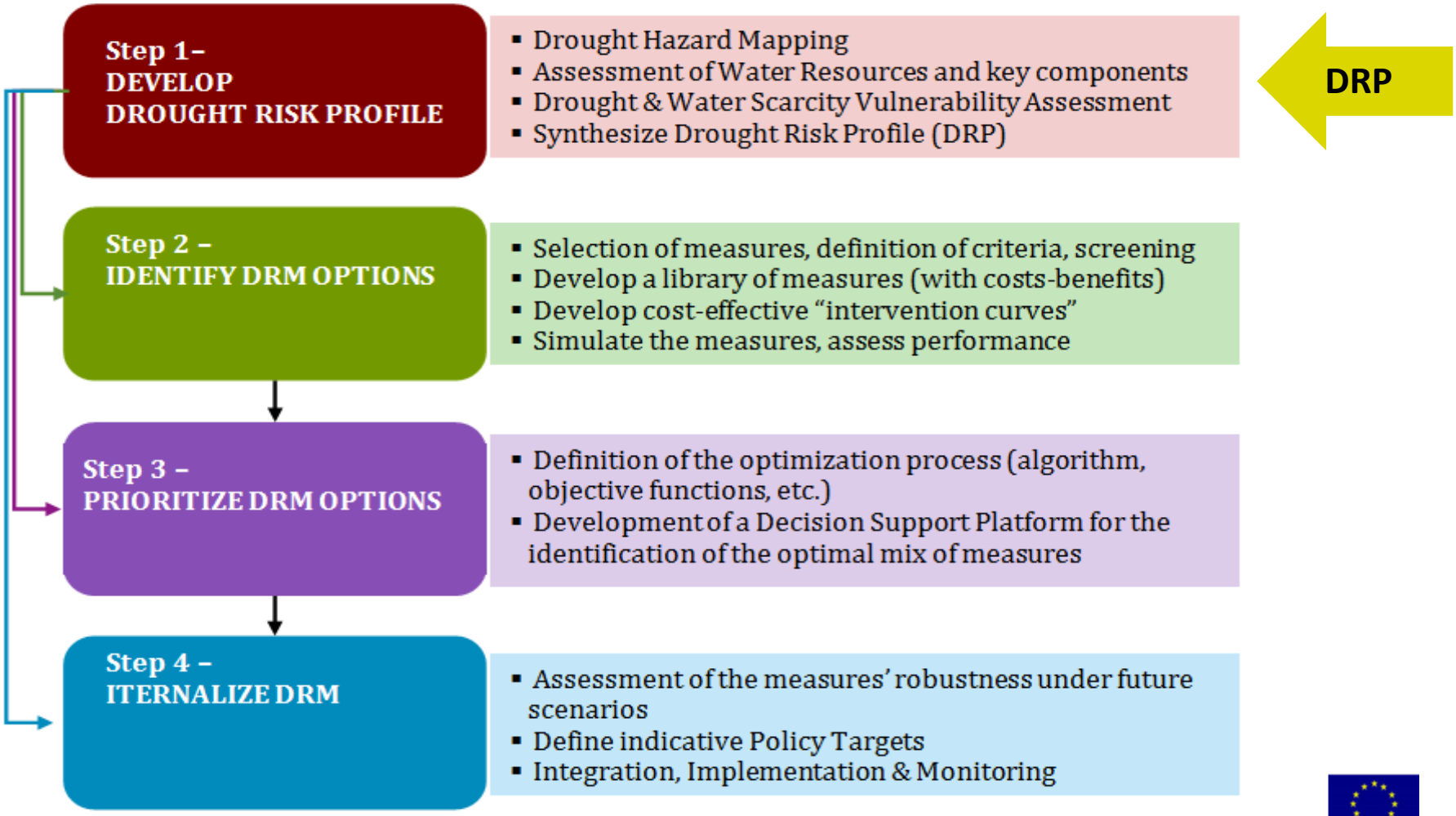
1. DRP part of Drought Risk Management Mainstreaming

- **Risk = Hazard x Vulnerability**



1. Drought Risk Profiling: problem statement

- Not an unique definition of risk
  - dependent on the combination of Natural Hazard and Vulnerability
- Many indicators to characterize the drought hazard and vulnerability are available
  - Most appropriate(s) indicators differ per region
- Methodologies and standard methodologies are lacking for drought
  - In contradiction with (for example) floods

1. Drought risk profile

Four steps

A. the analysis of the climatic hazard (drought hazard)

B. analysis of water scarcity

C. the subsequent analysis of vulnerability/resilience factors

D. the combination/integration of the above three

3. Water scarcity

- Many concepts developed
- Fraction of total runoff available for human use per capita
  - > 1,700 m3/cap, stress 1000 - 1,700 m3/cap, scarcity 500 - 1,000 m3/cap, absolute scarcity (< 500 m3/cap)
- Basic Human Water Requirements Index
  - Minimum total water demand of 50 liters per person per day
  - FAO: 50 – 100 l/day
- Water Availability Index (WAI)
  - ratio of surface runoff plus groundwater resources minus water demand over the sum of these three parameters
- Water Resources Vulnerability Index
  - ratio of total annual withdrawals to available water resources
  - 20- 40 % water scarce; > 40 % severely water scarce
- Watershed Sustainability Index (WSI)
  - Combination of hydrologic, environment and human indicators

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3. The Water Exploitation Index (WEI)

- Level of pressure that human activity exerts on the natural water resources
- Defined as the annual total water abstraction as a percentage of available long-term fresh water resources
- WEI+ is capturing the balance between Renewable Water Resources (RWR) and water consumption
- WEI+ = (Abstractions – Returns) / Renewable Water Resources
- RWR can be calculated either by the relationship
  - External Inflow + precipitation – evapotranspiration + storage change
  - Outflow + (Abstraction – Return) – changes in storage from artificial processes (regulated lakes or artificial reservoirs)

3. Relevant Water Stress Indicator (RWSI)

Relevant Water Stress Indicator (RWSI)

- Percent of Total Fresh Water Abstracted (ABS) over the total Renewable Water Availability (RWA).
- Could be difficult to assess
  - water exchanges between neighboring groundwater catchments

3. Percentage of Unmet Demand

- Percentage of unmet demand relative to total demand per sector
- Annually aggregated or per season (e.g. summer)

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4. Background of Assessment of Drought Vulnerability

A vulnerability assessment is **the process of identifying, quantifying, and scoring the vulnerabilities in a system,** with an ultimate target to identify risk, define priorities, select alternative response strategies or formulate new strategies

- Concepts of vulnerability
  - Many available, analyzed by many authors
  - Most common: the degree to which a socio-economic system or physical assets are either susceptible or resilient to the impact of natural hazards
- Determined by
  - physical, social, economic, environmental factors
  - interacting in space and time
- Multiple methods to systematize vulnerability
  - (a) the technical or engineering sciences perspective
  - (b) the social sciences perspective → the role of human systems

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4. Complexity of Drought Vulnerability

- Multi dimensional and differential
  - It depends on the local physical context
- Scale dependent
  - Local, regional, national
- Dynamic
  - Changing in time and space

4. Assessment of Vulnerability

Some general parameters

- Population density and Growth rate
- Rural population density
- Literacy rate
- Poverty rate
- Total water use per sector, Susceptibility of a water user
- Population without access to improved water (% of total)
- Income per capita
- % of workforce that works within community
- GDP form agriculture, Farm income
- Agricultural employment (% of total)
- % of Irrigated area over agricultural areas
- Area without any irrigation potential (%)
- Crop yield sensitivity
- Number of different crop categories, Crop diversification index
- Presence of government irrigation scheme
- Irrigation water use efficiency
- Losses in the water supply network
- Number of animal units/number of holdings
- Number of different livestock categories
- Insurance (€/agricultural holdings) , Subsidies (€/agric. holdings)
- Access to credit
- Governance (Share of tax revenue)
- Coping options (labor in industries)
- Legal & institutional frameworks

Vulnerability to Drought & Water Scarcity

Exposure, Sensitivity

(relates to DPSIR -pressures and state)

Water Resources availability/ exploitation
Water Demand/ needs
Population
Land Use
Economy & Living conditions
Infrastructure
Practices & Awareness
Ecosystem Goods & Services

Potential Impacts

(relates to DPSIR -impacts)

Environmental/ Ecological
Economic
Social

Adaptive capacity

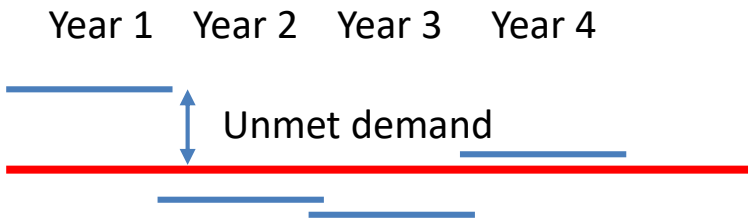
(relates to DPSIR -responses)

Ability, Resources and Willingness to mitigate, respond, recover

Institutions
Legislative framework
Economy
Technical capacity
Education
Social perception

4. Drought Vulnerability Index (DVI)

- Estimate **unmet demand:**
- With 3 sub-indicators
  - Reliability (REL)
  - Distance to target to meet demand (DIS)
  - Resilience to extreme conditions (RES)



$$DVI = \frac{score_{REL} + score_{DIS} + score_{EXT}}{3}$$

REL	percent (%) of years with unmet demand within the period of analysis	used as metrics of "water supply reliability"
DIS	Average unmet demand within the period of analysis as percentage (%) of the respective total demand	used as metrics of "distance to target"
EXT	Maximum annual unmet demand within the period of analysis as percentage (%) of the respective total demand of that same year	metrics of "resilience to extreme conditions"

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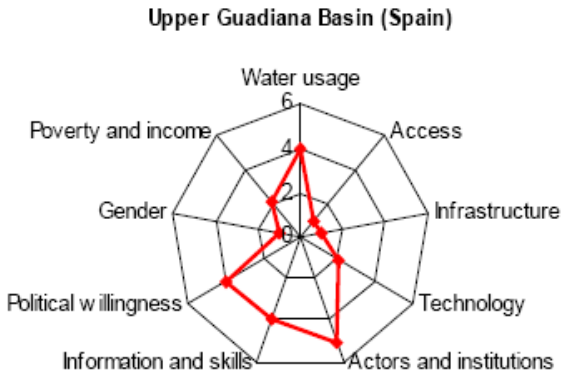
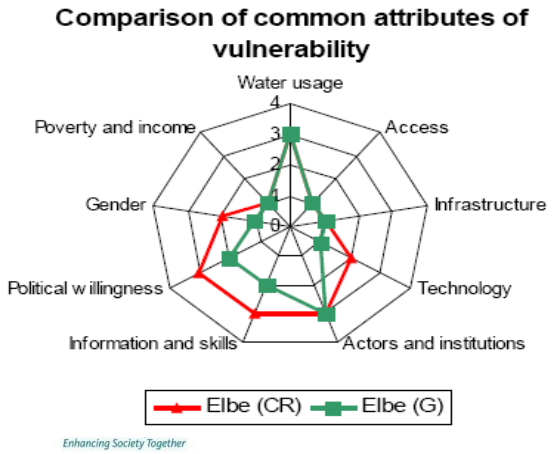
4. Assessment of DV - Some examples

Vulnerability profile

Upper Guadiana Basin, Spain (top)
Elbe RB, Czech Republic-Germany(bottom)
(Source: Downing & Bharwani, 2006)

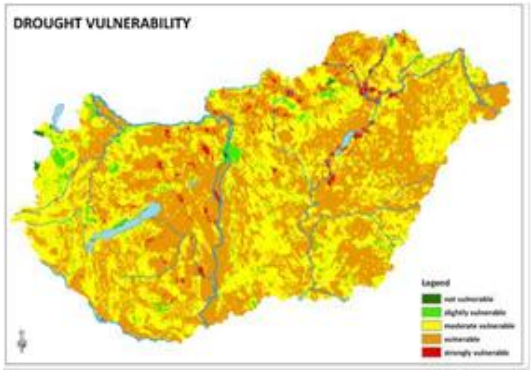




Multi-criteria simulations: Drought vulnerability map of agriculture in Hungary

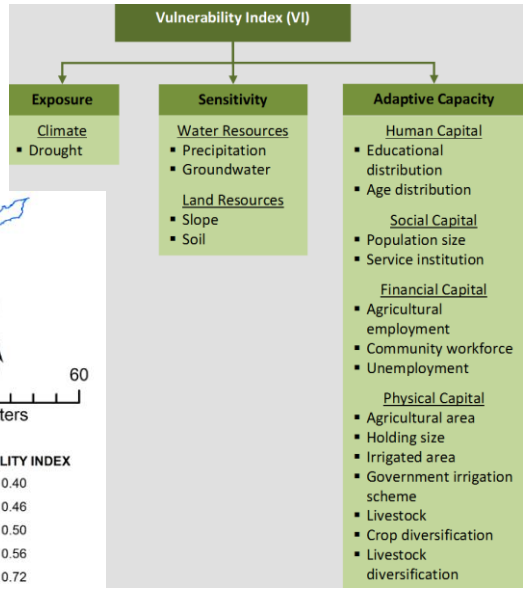
(Source: DMCSEE, Source: Gregorič, 2012)

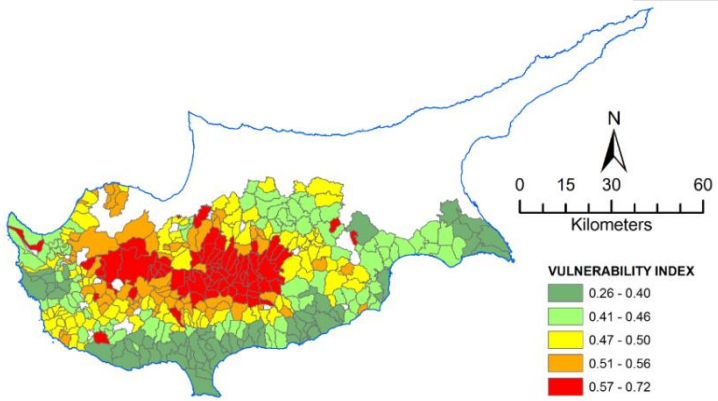
Physical factors (precipitation, solar radiation, soil water-holding capacity, slope)
Socio-economic factors (land use, irrigation)



Using a Blend of Indicators to derive Vulnerability Index

(Source: Deems, 2010)



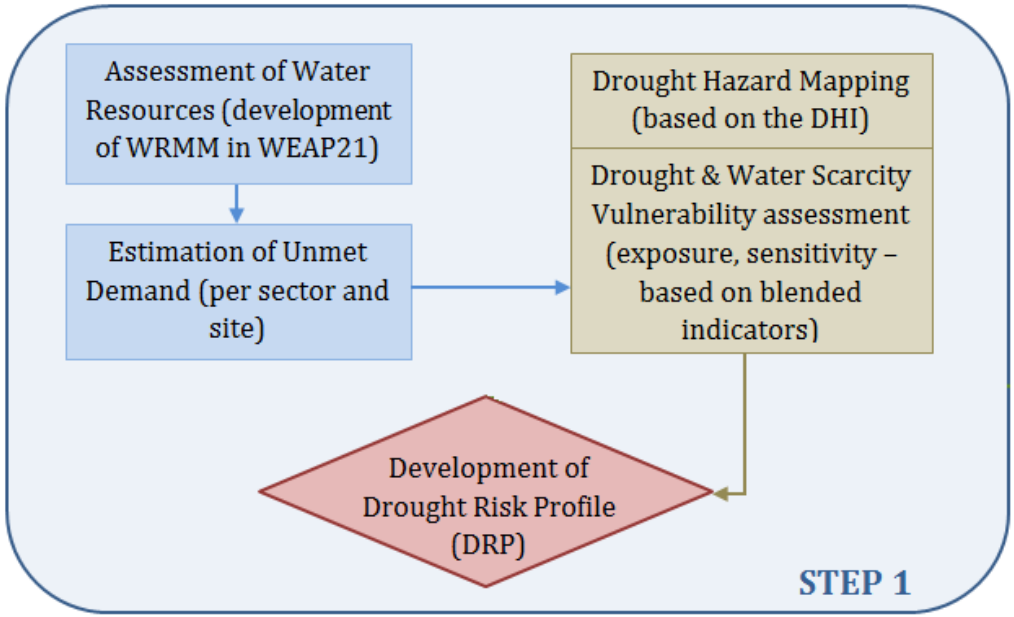


5. Drought Risk Profile

- Estimate the Drought Risk Profile

Risk = Hazard x Vulnerability ➔ **DRP = DHI x DVI**

- GIS processing for matching of spatial resolutions required



6. Towards a Risk Management Plan

- Make an early warning system
  - Using regional climate outlooks
  - Taking into account uncertainties in forecasts of the climatic conditions
- Addressing population dynamics and constraints on natural water resources
- Risk informed and sector specific disaster risk management plans
  - For example for agriculture
- Financial resource allocation and mobilization
  - establish both commitment and innovative approaches to leverage financial resources for disaster risk reduction
- Linking the development and humanitarian efforts
- Infrastructure development and technology transfer
  - Examples: Improved crop varieties and livestock breeds, drought resistant crops, water management, land restoration

6. Benefits of a agricultural risk plan

- Using the drought hazard zonation maps to develop:
  - irrigation schemes for the drought-prone zones;
- using the drought hazard risk profile
  - to develop insurance mechanisms
  - for specific regions or agricultural products;
- prioritizing and focusing interventions;
- developing contingency plans and improving preparedness;
- adapting agricultural practices
  - to specific areas, such as those prone to floods

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6. First three responses to an (imminent) drought

Avoid

- Implementing measures so that the threat cannot happen or its effect cannot be felt.
  - Example: avoid any crops which have high water requirements and long growing periods.

Reduce

- Minimizing either the probability of occurrence or the impact of the event.
  - Example: supplement agricultural activities with drip irrigation

Fallback

- Operationalizing contingency plans
  - Example: a plan should be in place to provide for basic needs of the affected people so that a famine situation does not occur.
  - Communities may have alternative livelihoods in place, which are implemented when a drought is likely to affect them.

6. Next three responses to an (imminent) drought

Transfer

- Implementing an insurance approach to take care of losses, may the event occur
  - Example: farmers who implement recommended (local) practices can benefit from insurance coverage if a drought occurred and affected them.

Accept

- Deciding to change nothing, as the change or actions taken would not be worth implementing

Share

- Deciding to spread the cost of impacts to other stakeholders

Source: FAO, Mainstreaming climate related disaster risk reduction in agriculture and food sectors in eastern Africa, 2017

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Thank you for your attention.

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