WANDEL
Case study IV Drâa Valley, Morocco

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WANDEL
Wasserressourcen als bedeutsame Faktoren der Energiewende auf lokaler und globaler Ebene

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Local and regional level – Case studies

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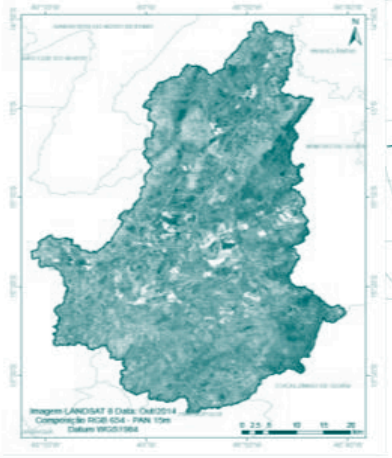
Concentrated Solar Power (CSP)

Einzugsgebiet
Drâa-Valley (Marokko)

Large-Scale Hydro Power

Einzugsgebiet
Ober- und Mittelweser
(Deutschland)

Einzugsgebiet
Rio dos Patos (Brasilien)



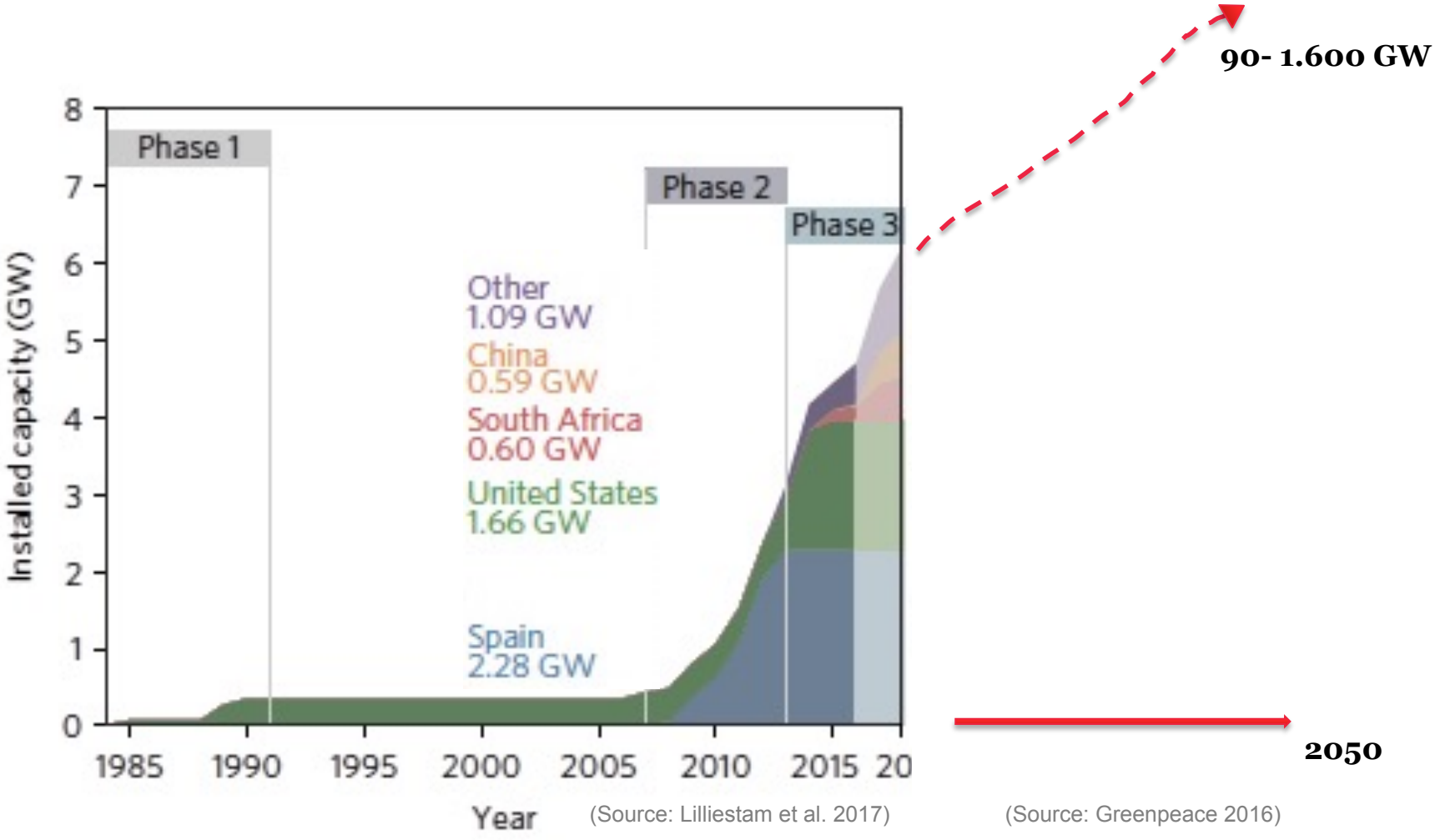
Einzugsgebiet
Obere Donau
(Deutschland)

Biomass

Coal

WANDEL: Case Study Concentrated Solar Power (CSP)

Developement forcast for CSP in 2050



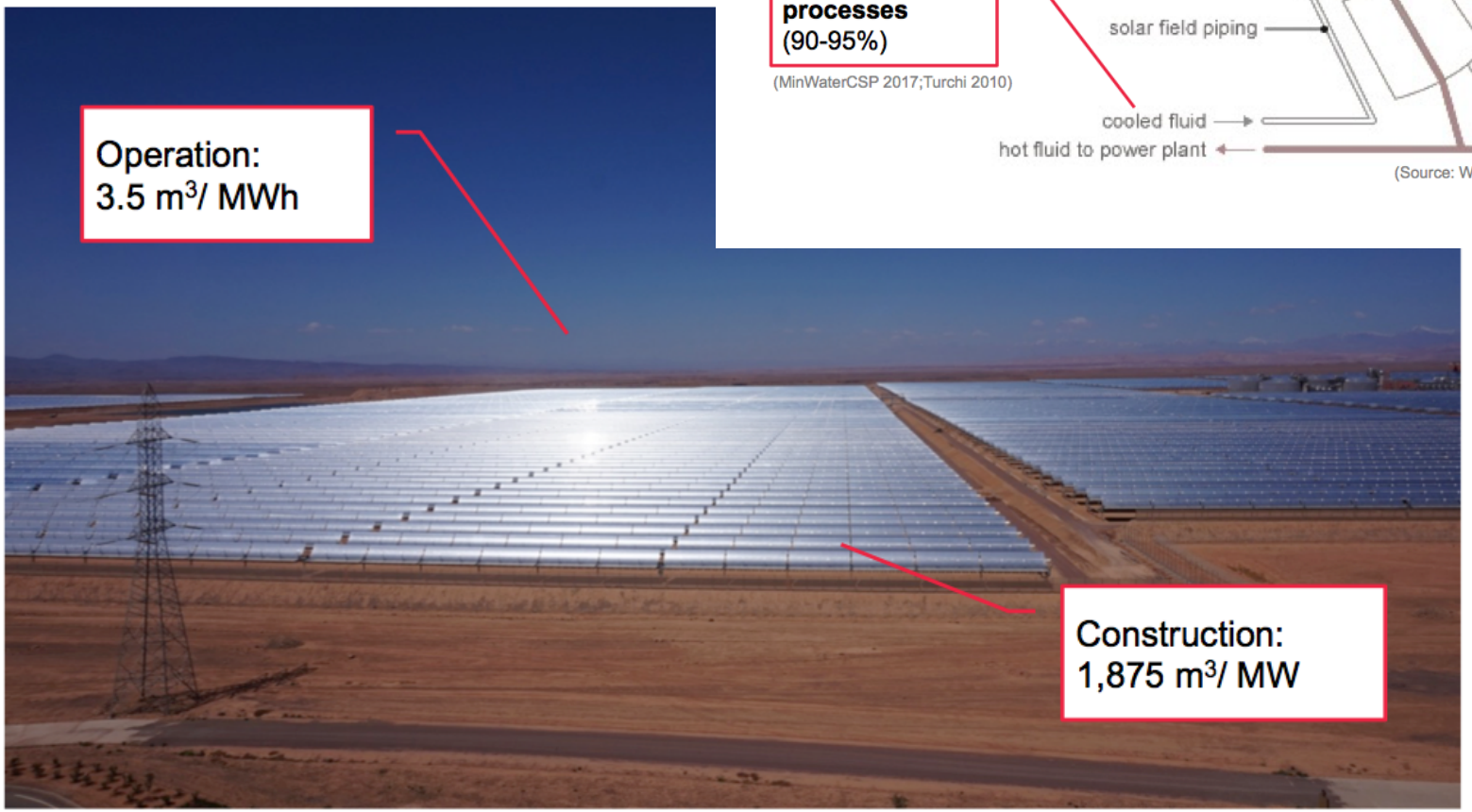
(Source: Lilliestam et al. 2017)

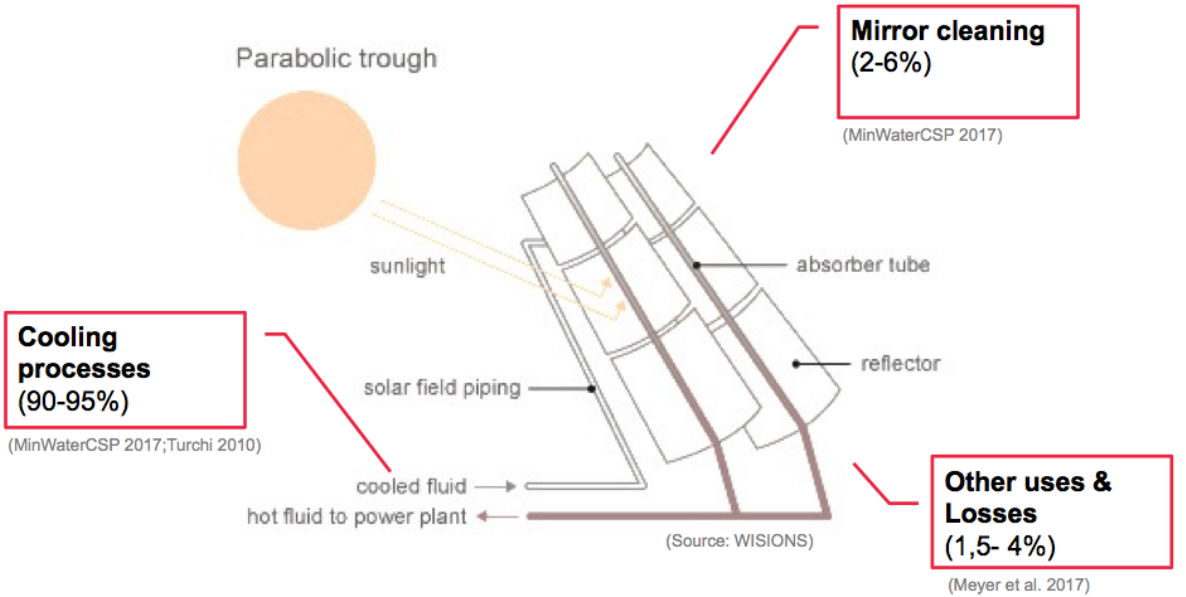
(Source: Greenpeace 2016)

"In research, politics and industry **the issue of water conservation is a key challenge** in order to promote the **acceptance** and further **implementation** of CSP technology." (DLR 2016)

Concentrated Solar Power (CSP)

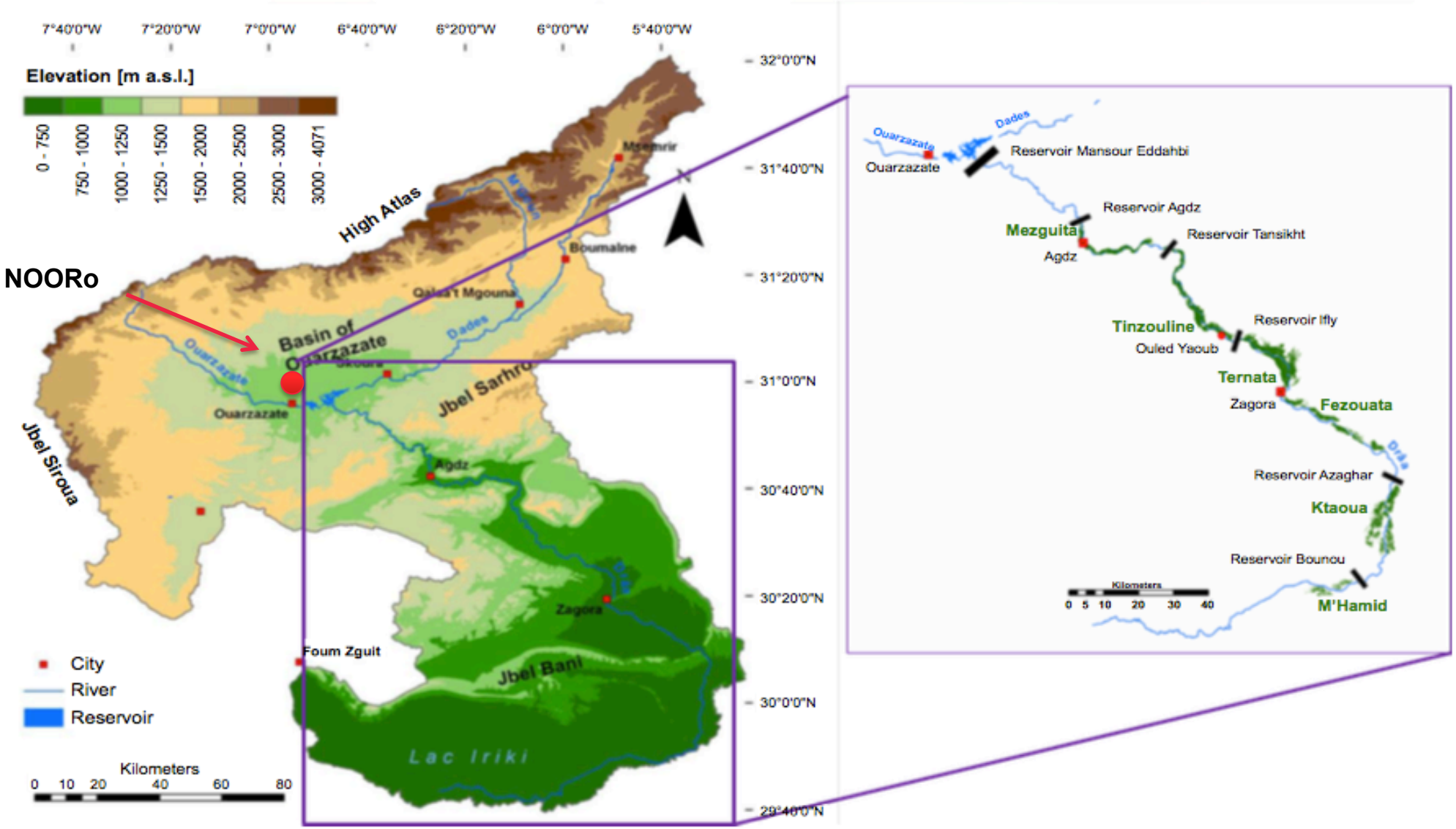
Average water demand of CSP power plants with water cooling (%) and forecast of average water demand at Noor$_o$ I – CSP Plant in Ouarzazate





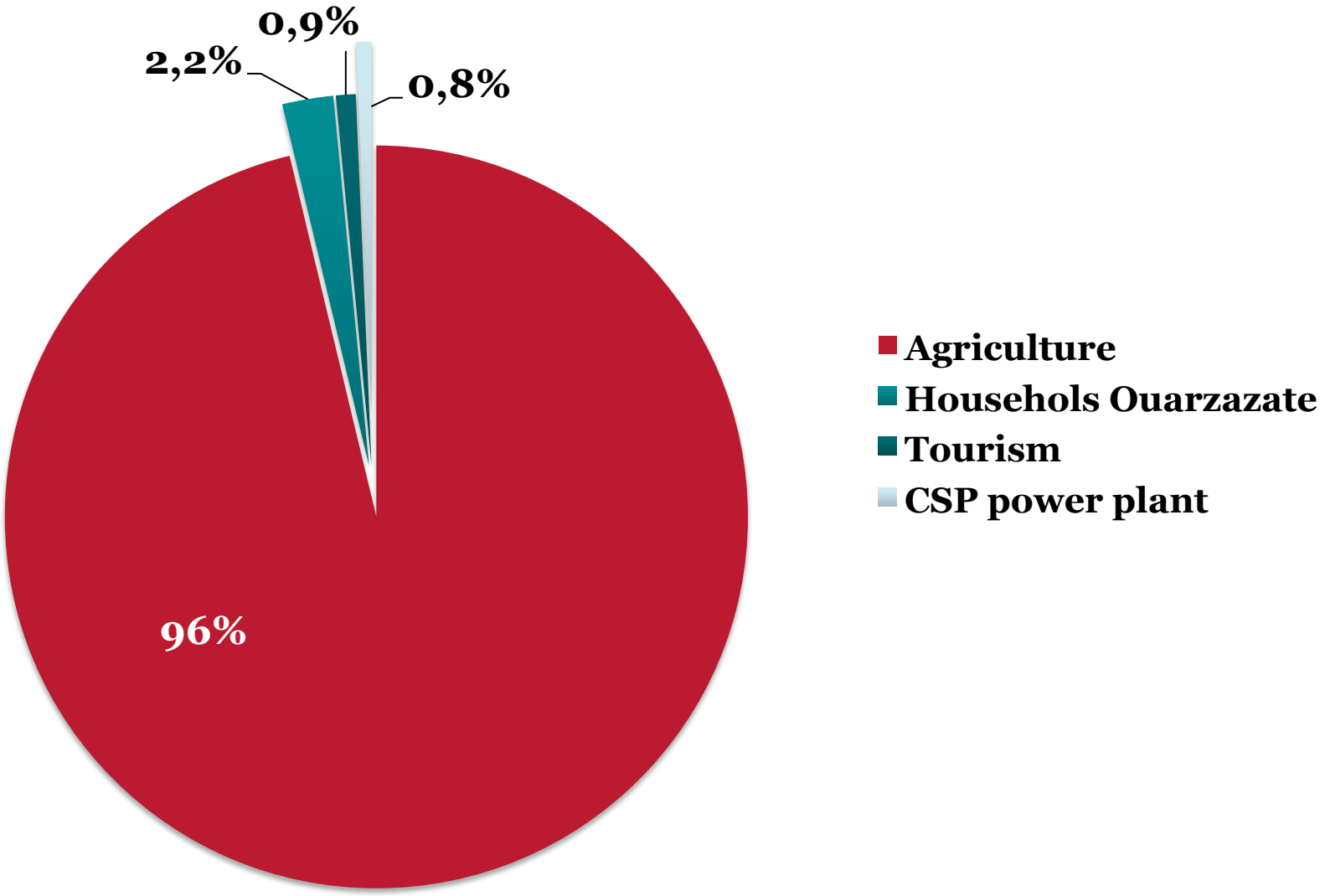
(Data source: Report SocialCSP 2015)

Research area
Drâa Valley and Ouarzazate



(Source: Karmaoui et al. 2014)

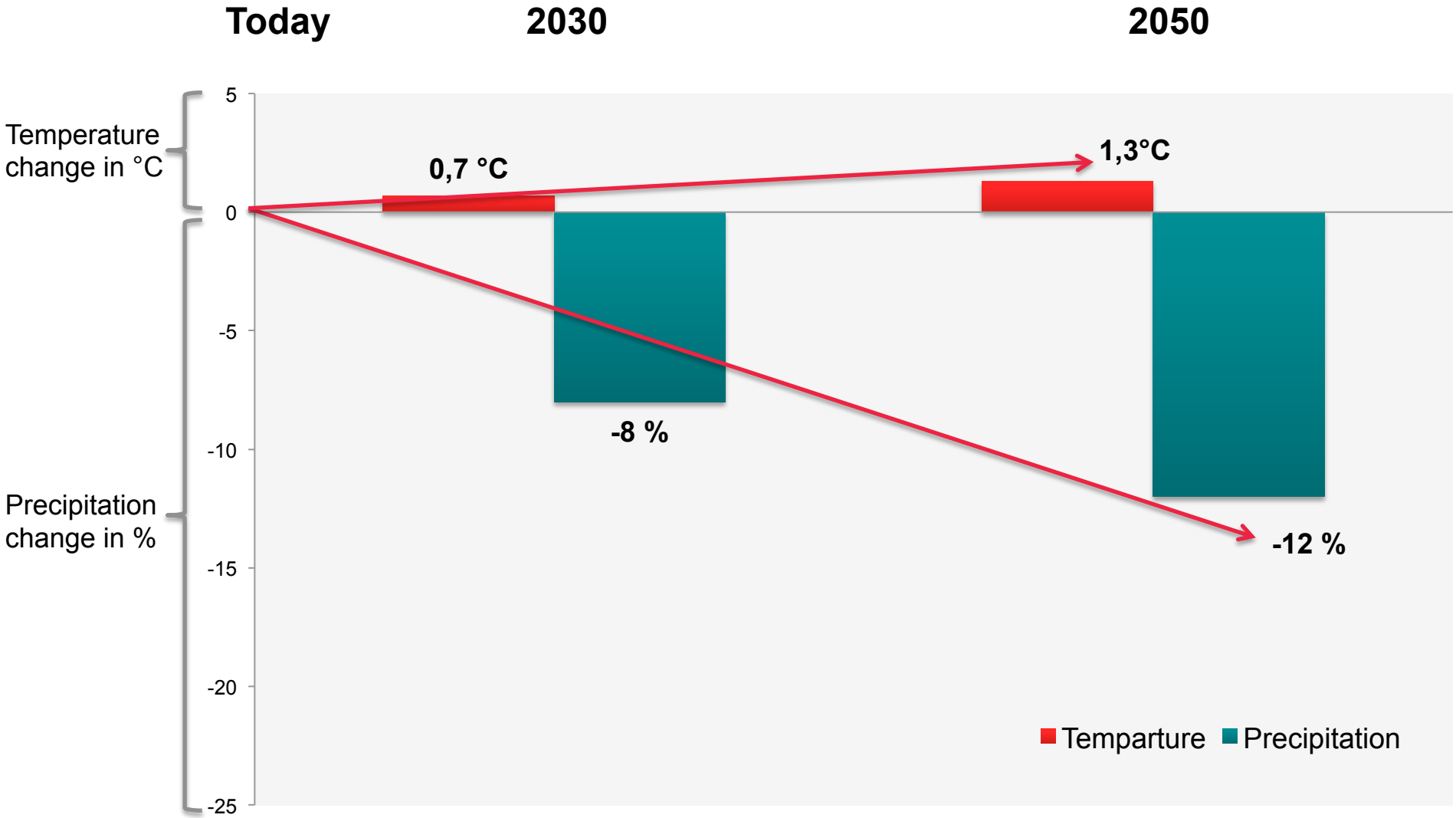
Share of water uses Mansour Eddahbi reservoir



(Sources: Heidecke 2009; Busche 2012; Social CSP 2015, Karmaoui et al. 2016)

Water supply scenarios

Climate change scenarios temperature and precipitation trends in the region of the Drâa Valley



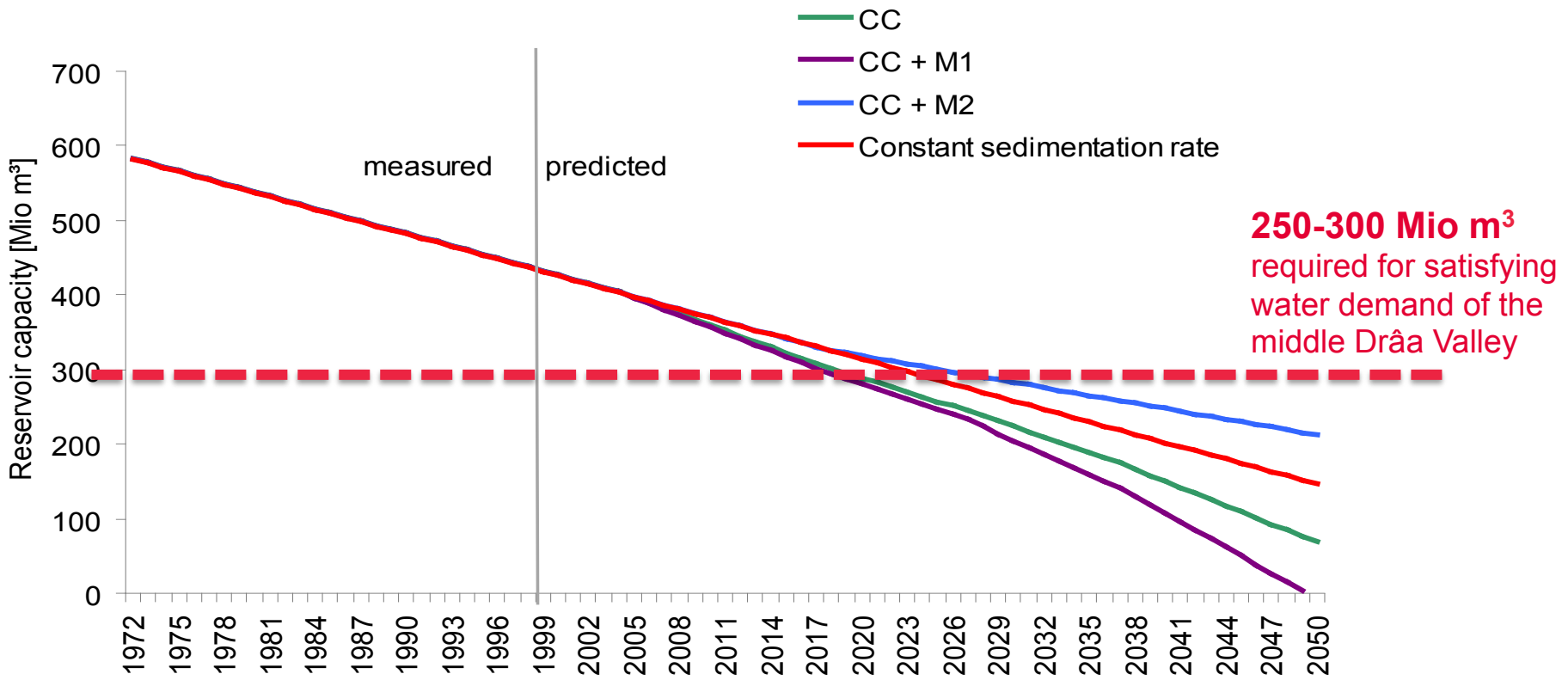
Temperature and precipitation trends from REMO compared to baseline 1978-2007

(Source: Busche 2012)

Water supply scenarios

Water availability “Mansour Eddahbi” reservoir under consideration of climate change scenarios

Diekkrüger et al. (2010):



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First working step

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Scenario development

Water supply

Future water supply considering **climate change impacts**

➜ **Water resource scenarios:**

(data based on climate change scenarios)

W1 W2 Wx

Water demand

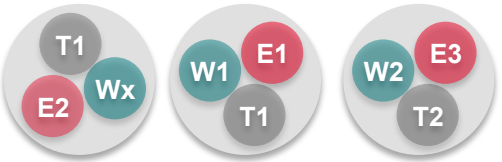
Future development with regard to **socio-economic pathways and technologies**

➜ **Water demand scenarios:**

(Scenario development and validation together with local stakeholders)

T1 Tx E1 E2 Ex

Scenario combinations



Critical combinations?

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Second working step

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Measures to avoid critical scenarios

Measures with focus on energy

Technological options to reduce the water consumption of the power plant

M1 M2

Measures with focus on water

Sectorial options to reduce the water consumptios in sectors such as agriculture etc.

M3 M5 Mx

Criteria for assessment of measures

Multi-criteria assessment of measures

Preferred measures

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Third working step

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Development of potential solutions

Assessment approach

Ranging from the regulatory framework and governance systems respectively

Framework

Regulatory framework, social and political context

Identification and discussion

Potential solutions for addressing challenges in middle and long-term (participative modelling)

Implementation

Institutional innovations and implementation plan

Derivation of conceptual framework

Systematization of developed approaches and methods for transferability to **further regions** with similar challenges

1st Workshop Ouarzazate

Thematic focus

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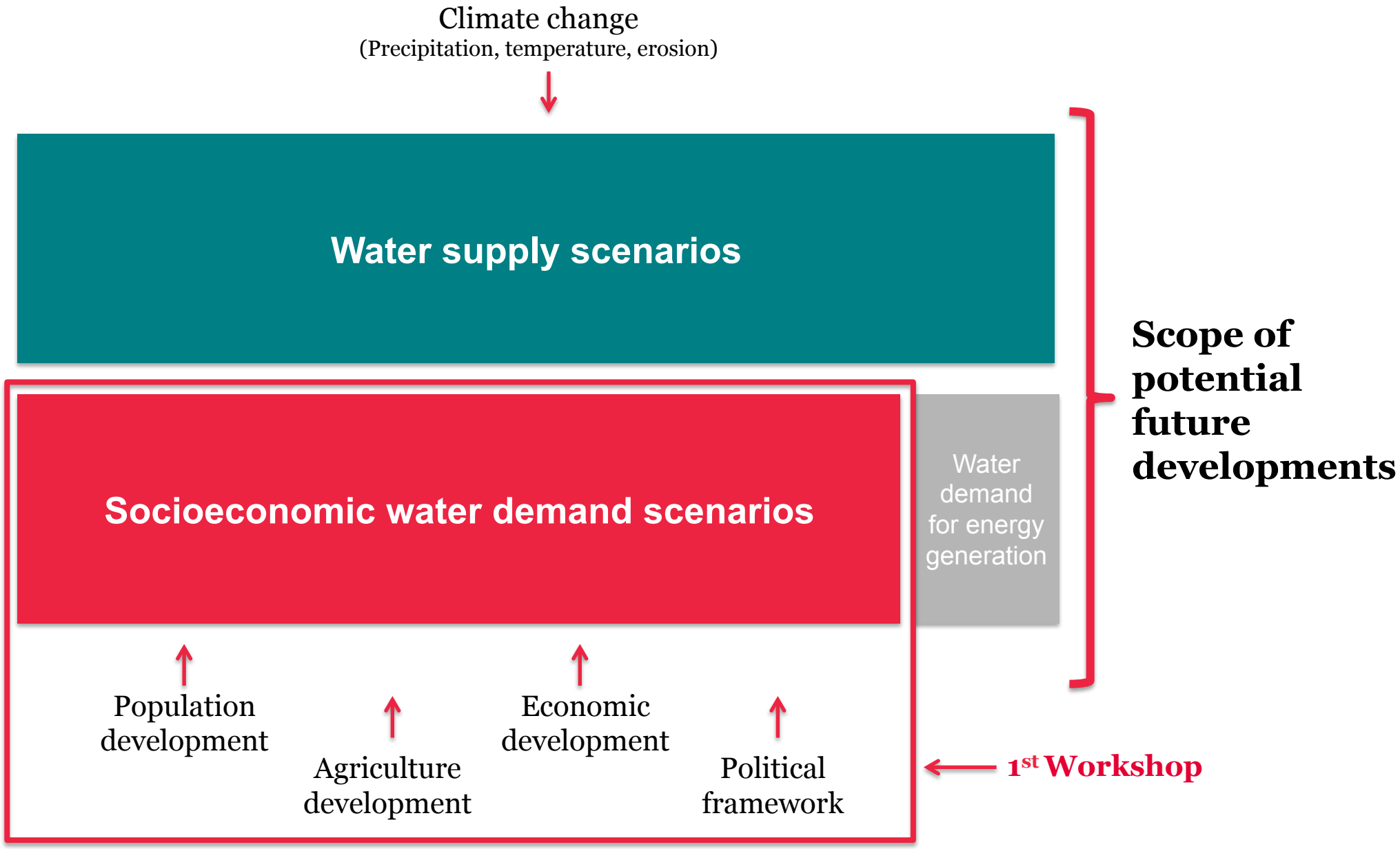

Identifying factors influencing the water demand

System mapping based on literature review

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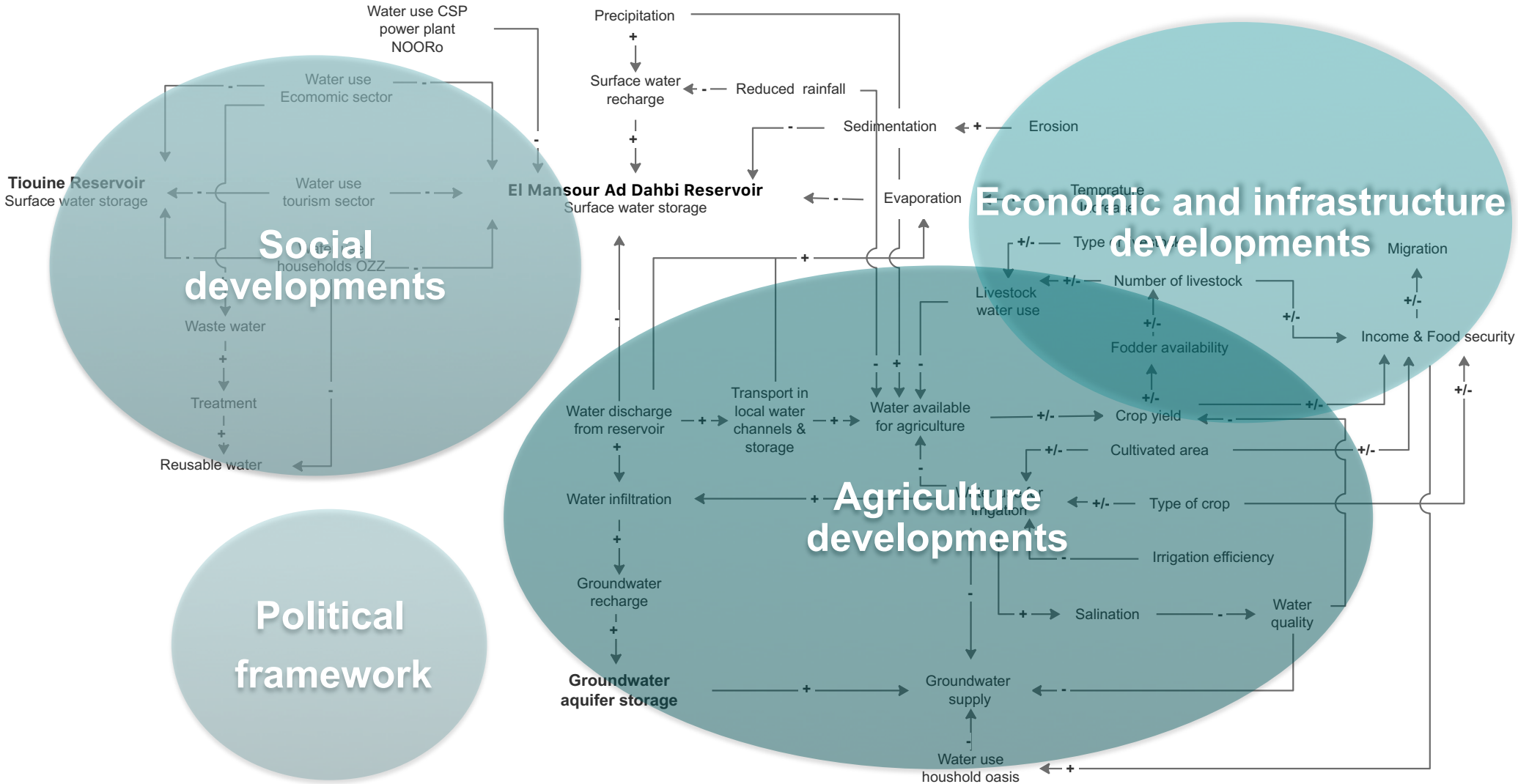

Identifying critical links

Overview links influencing the water demand and use

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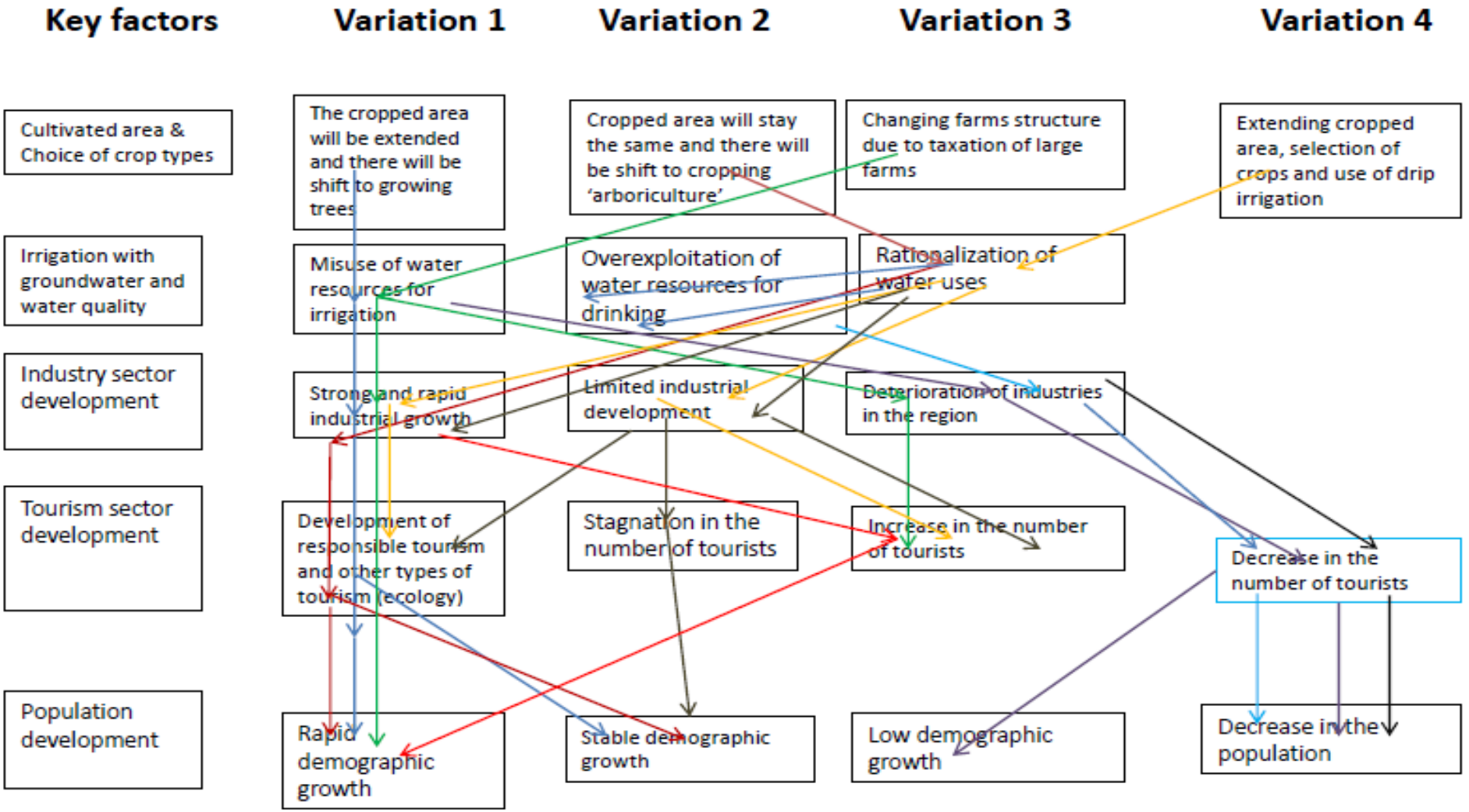
Agriculture developments	Social developments	Economic & infrastructure developments	Policy framework
Cultivated area	Population development (oasis/ towns)	Tourism sector development	Subsidies and support programs
Choice of crop types	Lifestyle developments	Industry sector development	
Irrigation with groundwater	Food production	Economic development	
Irrigation efficiency		Transport infrastructure development	
Livestock numbers			
Water quality			

Key factor analysis

Discussion of potential future developments of key factors



(Source: MENARES 2018)

Scenario storylines
Overview

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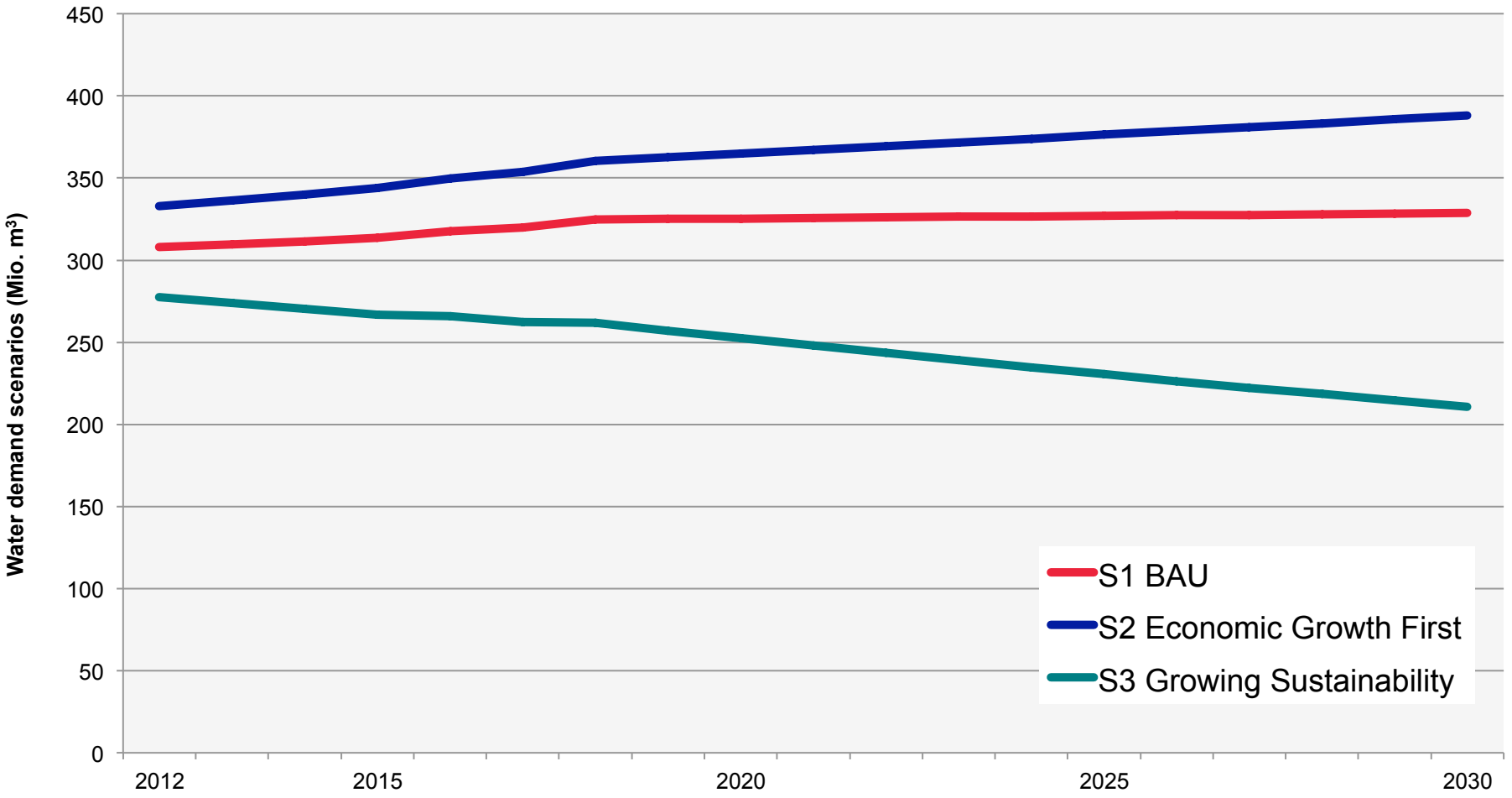
S1 Business as usual	S2 Economic growth first	S3 Growing sustainability
		
A scenario that assumes there will be **no significant changes to current water use patterns** in agriculture and no major changes in water use technologies. People's priorities remain the same and no major changes in policies occur.	A scenario that assumes the **exploitation of water resources to foster rural development**. Focus on cash crop production and modern technologies promise short-term economic benefits until water resources are exhausted.	A scenario that assumes a development which stays **within the sustainable limits of the available water resources** by applying various water conservation and efficiency measures. Strong commitment by population to avert a water crisis.

Scenario storylines

Quantification of water demand scenarios for 3 different storylines



2nd Workshop Ouarzazate

Evaluating measures to address water challenges

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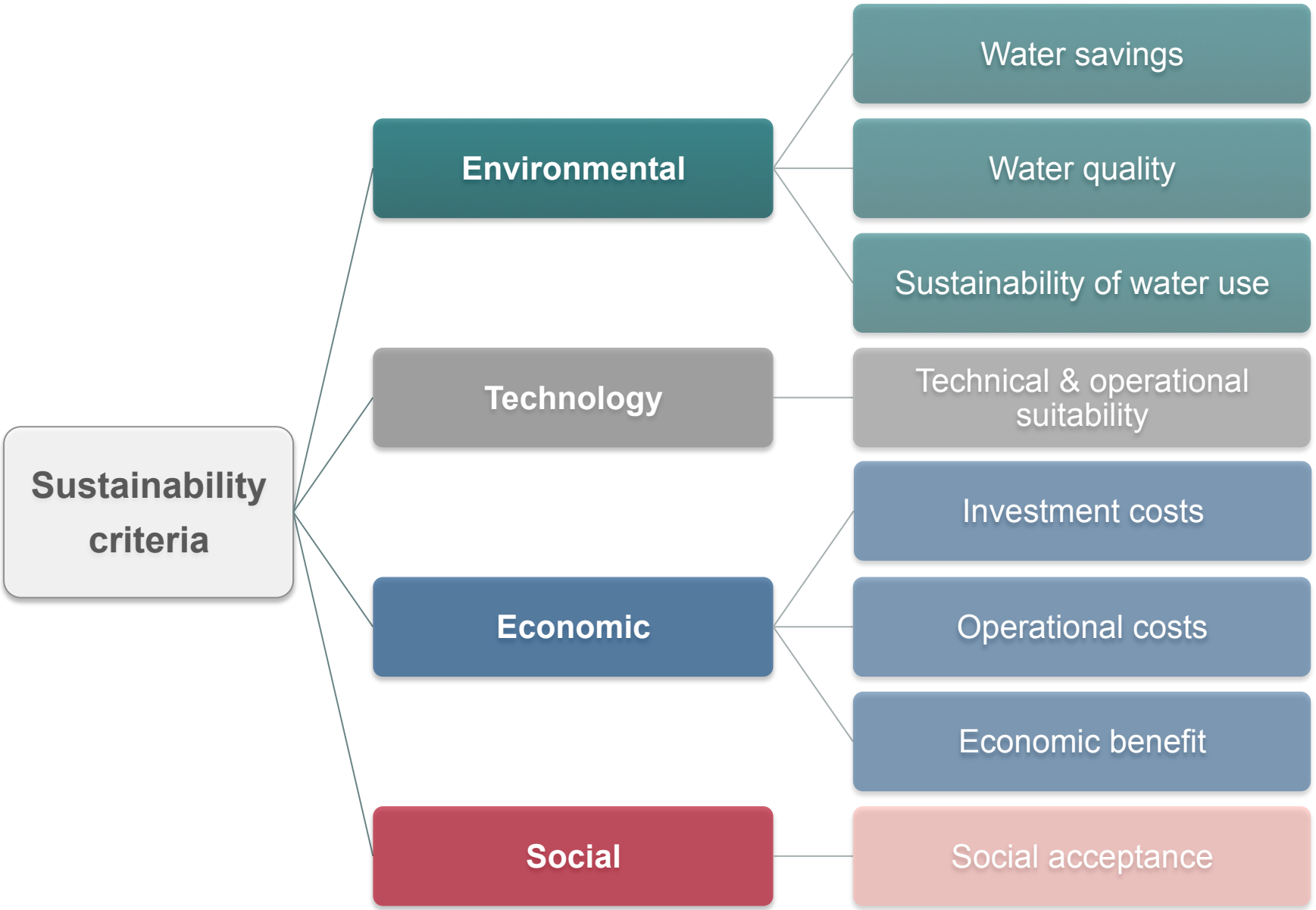
Evaluation criteria

Criteria overview and relevant factors for measures



Evaluation Criteria

Criteria weighting

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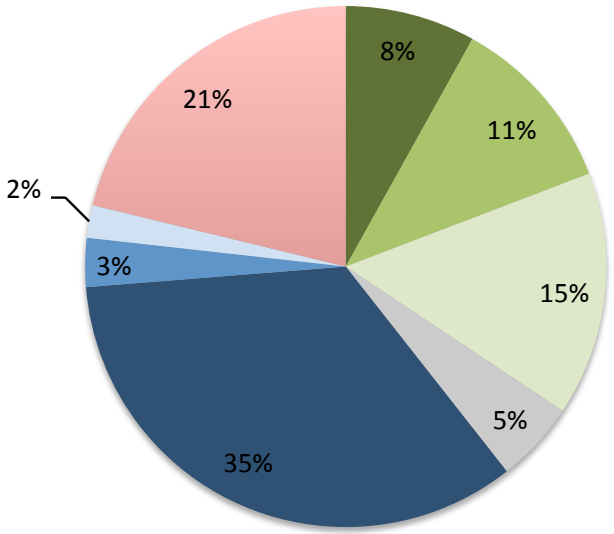
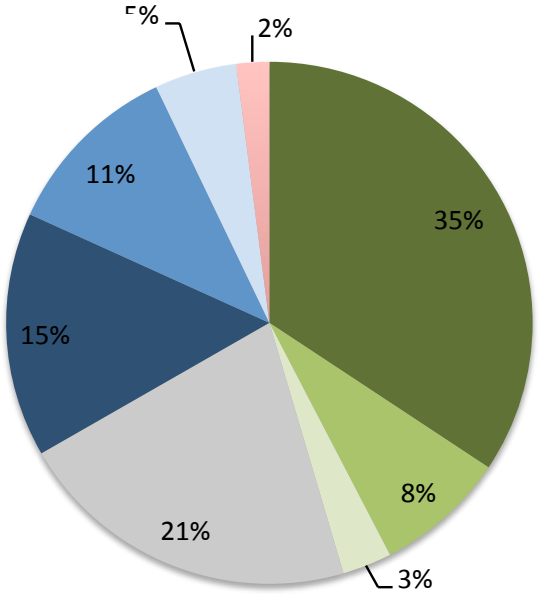
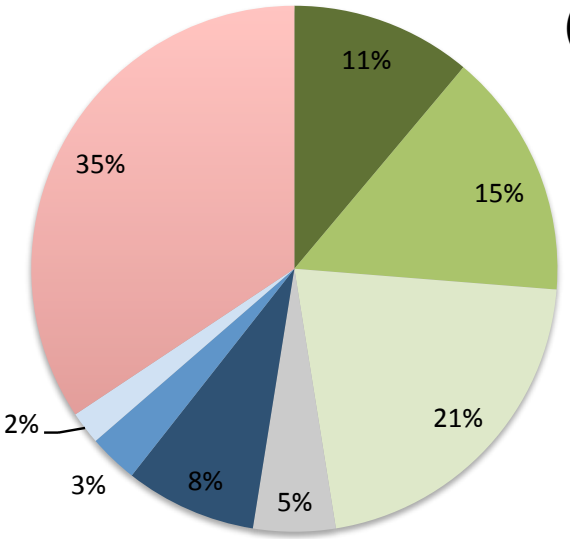
Farmers



Administration



Civil society group



- C1 Water savings
- C2 Water quality
- C3 Sustainability of water use
- C4 Technical and operational suitability
- C5 Investment cost
- C6 Operation & maintenance costs
- C7 Economic benefit
- C8 Social acceptance

Water saving measures

Categories of the measures

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14 measures

Water conservation

Measures aiming at the conservation of water sources and thereby the increase of available water

Water efficiency

Measures aiming at efficient water use, for example by applying modern technology

Water policy

Measures aiming at increasing the attractiveness of water efficient and conserving behaviour and technologies

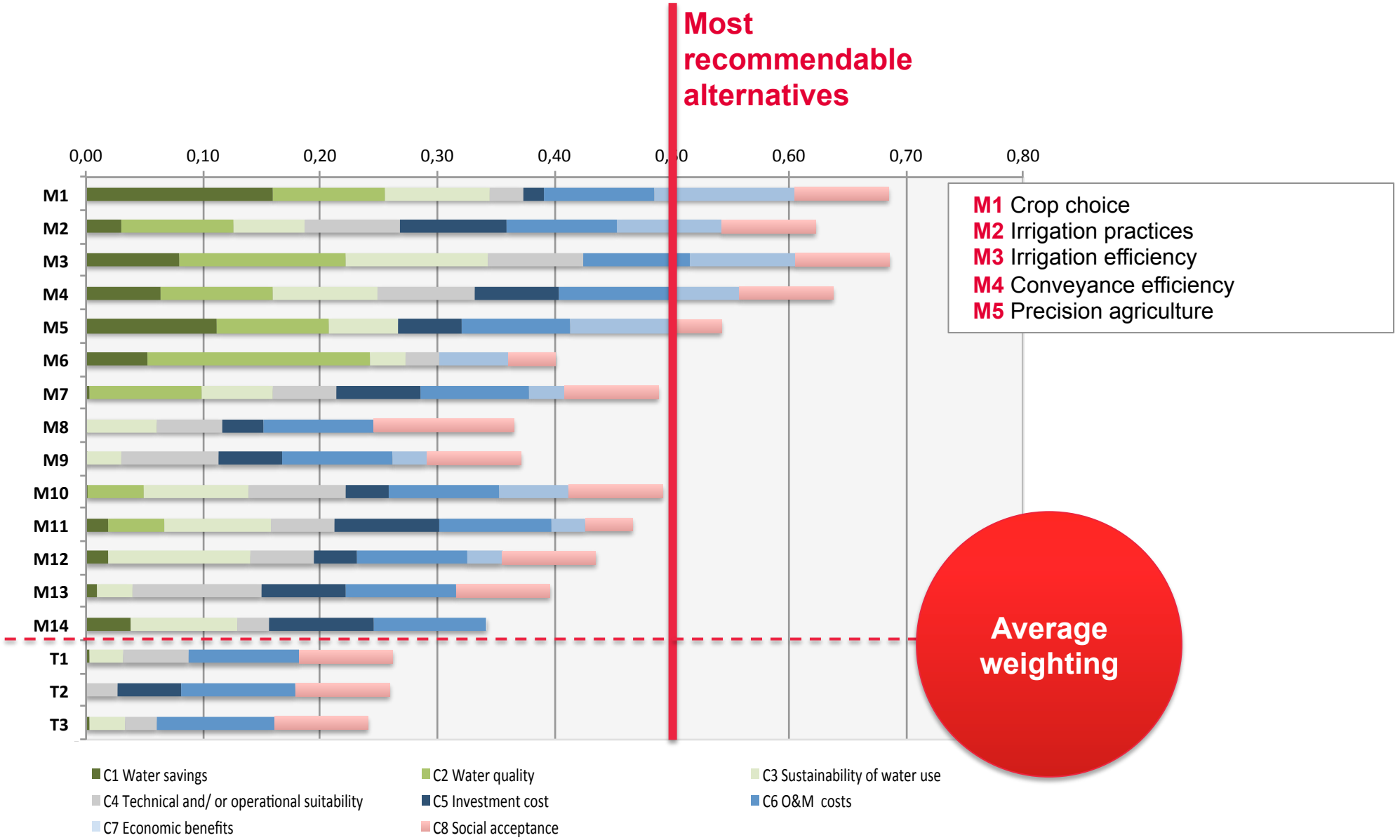
3 measures

Energy technology measures

Measures aiming at increasing the attractiveness of water efficient and conserving behaviour and technologies

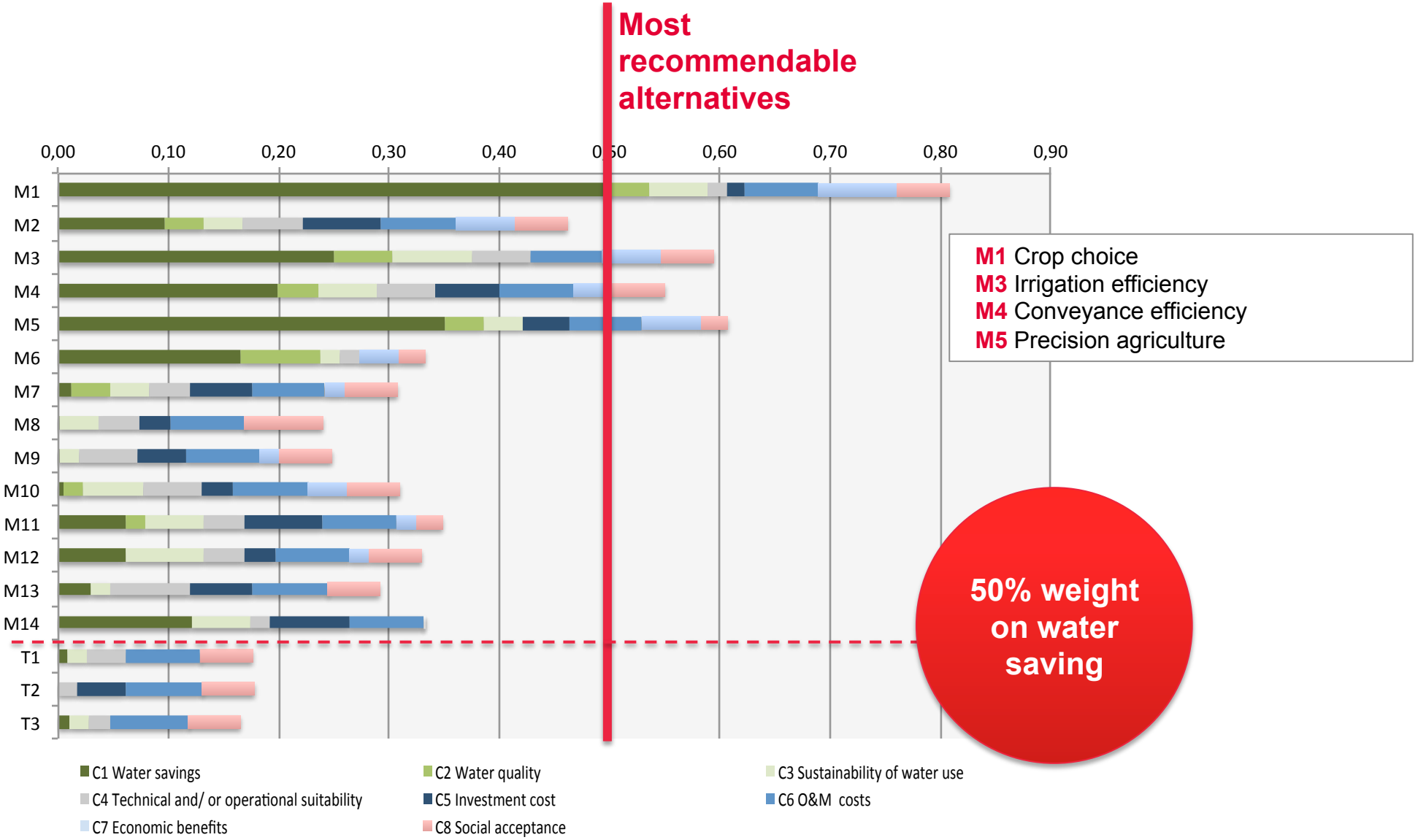
Evaluation of measures to address water challenges

Results Multi criteria-analysis (MCA)



Evaluation of measures to address water challenges

Results Multi criteria-analysis (MCA)



Evaluation of measures to address water challenges

Results Multi criteria-analysis (MCA)

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Most recommendable alternatives

M1 Crop choice	4
M2 Irrigation practices	4
M3 Irrigation efficiency	4
M4 Conveyance efficiency	5
M5 Precision agriculture	3
M7 Wastewater treatment	1
M11 Aligning the national water and agriculture strategies	1

- These measures are evaluated to be preferable, **regardless of the weighting-set applied**, and all of them **focus on the agricultural sector**.
- **Technological adaptations** in **the solar thermal power plants**, on the other hand, **are less advantageous alternatives**.

3rd Workshop Ouarzazate

Evaluating governance concepts to address water challenges

Solution strategies

Evaluating opinion and attitude of stakeholders to address water stress reduction strategies

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Overall objective

Debate between stakeholders and multi-stakeholder understanding

Ranking strategies

In different group discussions strategies are ranked conform the implementation on the respective measures

Consensus finding

- Targeted training and information of citizens is the first step towards introducing water saving measures
- Assistance in implementing technical solutions as prerequisite
- Combining measures from other regions of the world with traditional working methods to counteract water scarcity

Conclusion

Capacity building in the context of the Water-Energy.Nexus

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- Interdisciplinary research is needed to address the **Water-Energy-Nexus** at different levels and to consider relevant stakeholders

- Participatory approach resulted in substantial **learning effect**
  - **Long-term thinking**
  - **Dynamic thinking**
  - **Multi-criteria assessment**

- Local workshops contribute to **horizon awareness** for environmental conservation topics

- Capacity building and bringing different stakeholder together result in **high acceptability** of implemented measures and strategies

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Thank you very much for your attention!

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