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Water use and human development under societal and climate change scenarios in Mediterranean countries

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POLITÉCNICA

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Socio-economic and environmental prospective for the Mediterranean Region :

The MedPro Project

- EU-Funded FP7 Project
- 17 research partners from 13 countries (EU and Southern and Eastern Mediterranean regions)
- www.medpro-foresight.eu

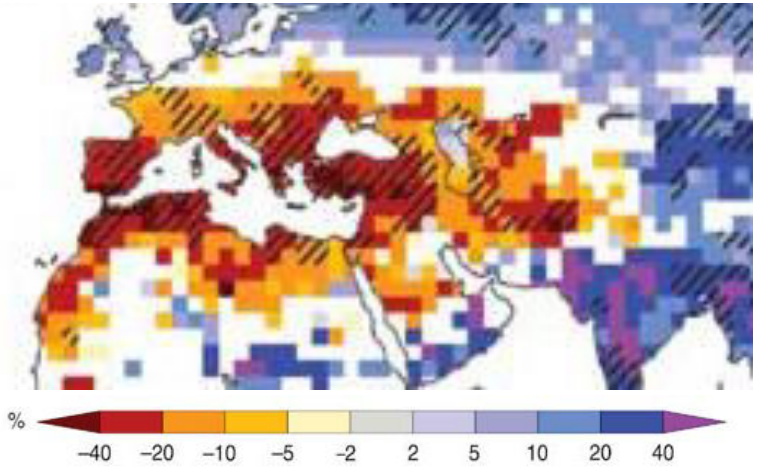
*** Some scenario-based water indicators are part of the results of the EU FP6 SCENES Project "Water scenarios for Europe and for neighbouring states"**

Water resources in the Mediterranean

• The Mediterranean region is one of the most water scarce regions of the World, both with respect to natural resource availability and to resources exploitation

• **Climate change** and **societal transformations** pose substantial challenges for water management in the future → severe implications for water and agriculture, threat to **socio-economic development**, **natural resources degradation** and social instability

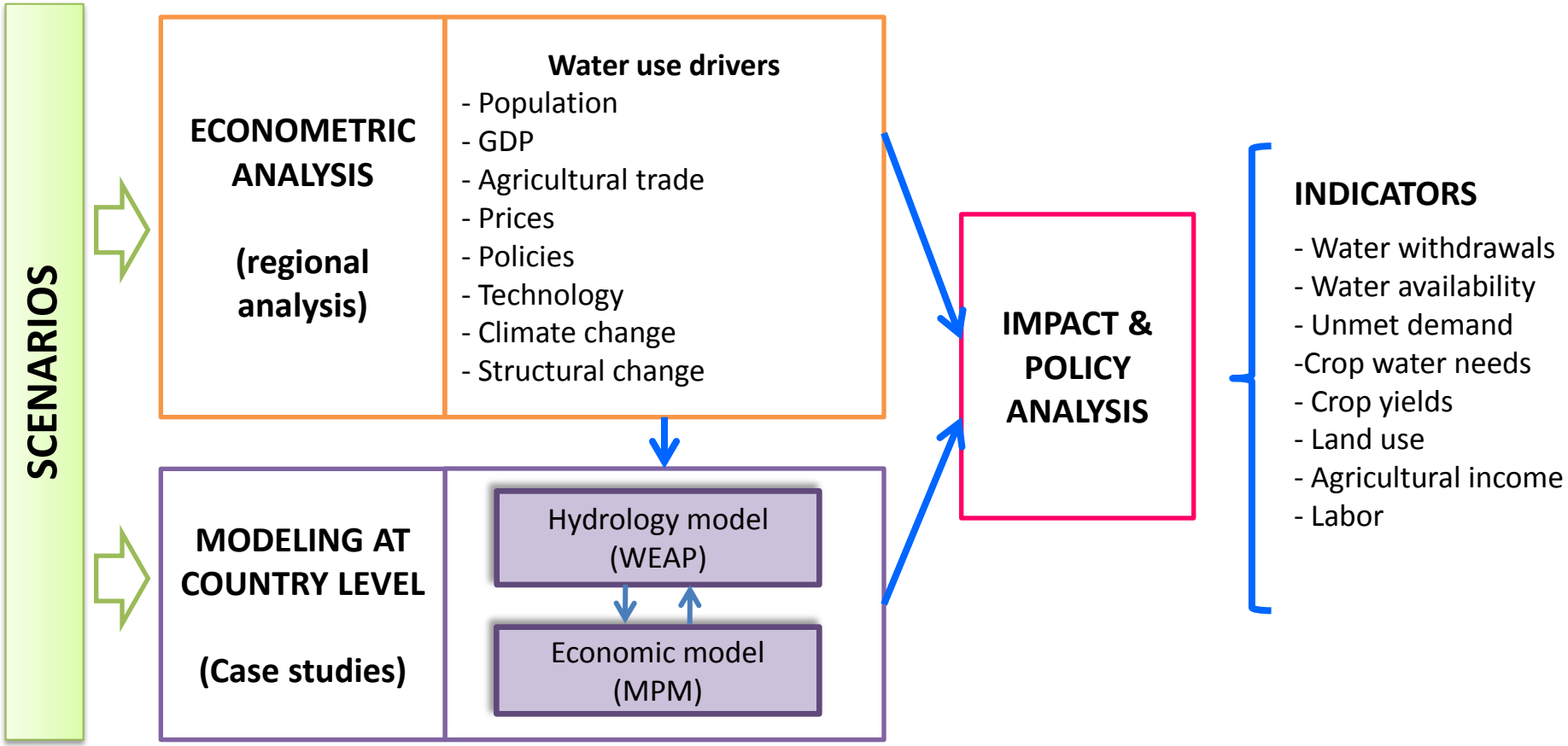
Projected changes in annual runoff (2090–2099 wrt 1980-1999)



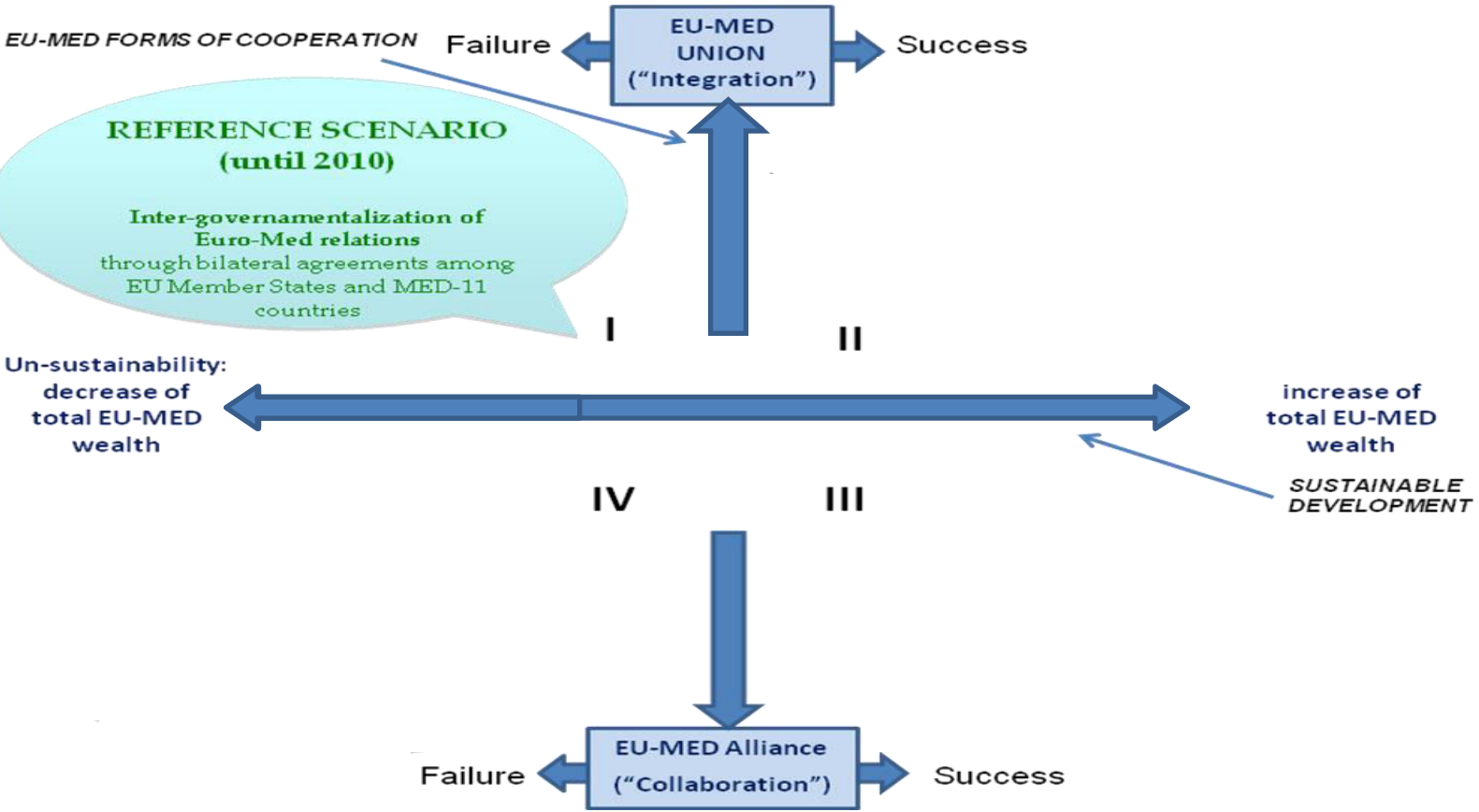
Source: IPCC (2007)

How will climate and societal changes affect future water use trends?

Methodological Framework



MEDPRO socio-economic scenarios



MEDPRO scenarios: key drivers for water and agriculture

	REFERENCE scenario (QI)	Sustainable development & EU-Med Union (QII)	Sustainable co-development of EU & Med sub-regions (QIII)	Euro-Mediterranean area under threat (QIV)
Population growth	High	Medium	High	Medium-low
GDP growth	Medium	High	High	Low
Irrigation area expansion	Medium (limited to irrig. potential)	Low	Low	Medium (limited to irrig. potential)
Agricultural trade	Low	High	Medium	Medium
Climate change impacts	Lower water supply Change in crop yields and CWR	Lower water supply Change in crop yields and CWR	Lower water supply Change in crop yields and CWR	Lower water supply Change in crop yields and CWR
Technical water use efficiency (on-farm and out-farm)	Little change	Medium increase	Medium increase	Little change Technologies outdated
Water demand policies	WFD fails	WFD succeeds (decrease of WC through prices and quotas)	National policies inspired in WFD, difficult implementation (medium-low decrease of WC)	Reactive measures (ex-post). Focus on security
Structural and governance change	Environmental degradation, medium awareness, poor governance	Environmental enhancement High environmental awareness	Environmental enhancement High environmental awareness	Strong env. degradation, low awareness, difficult governance

Econometric model: long-term projections of water withdrawals in the MED11

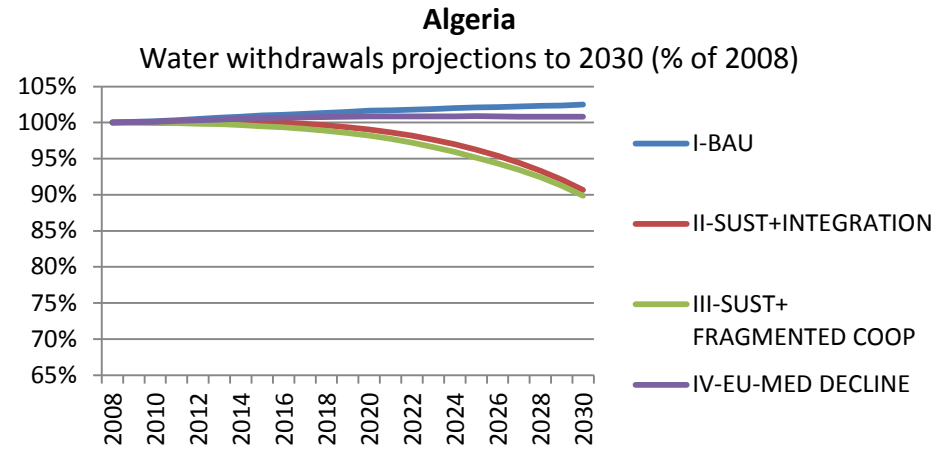
OLS, panel data, MED11 countries, 29 years (1980-2008)

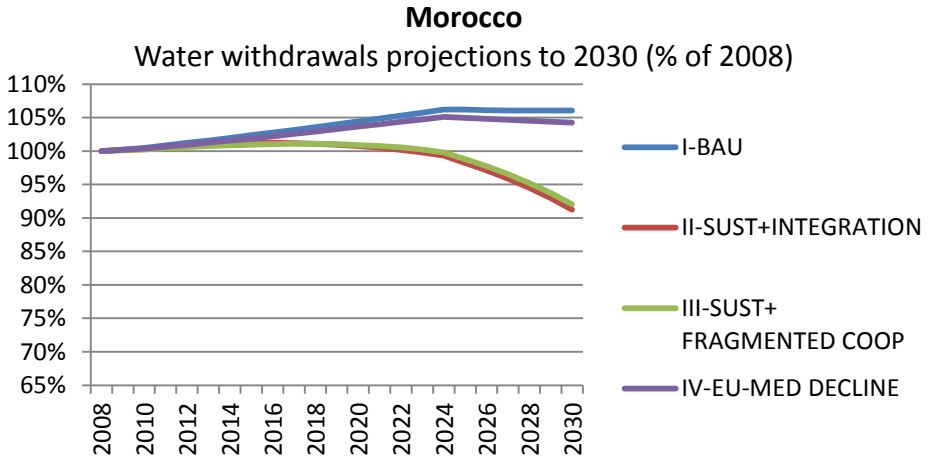
$$\mathrm{Ln(WW)} = \propto + \beta_1 \mathrm{Year} + \beta_2 \mathrm{GDP} + \beta_3 \ln(\mathrm{Population}) + \beta_4 \ln(\mathrm{I.Area}^2) + \beta_5 \mathrm{Imp.Cereal} + \beta_6 \mathrm{Imp.(Veg\,\&\,Fru)} + \beta_{7-16} \mathrm{Dummy}_{1-10} + \varepsilon$$

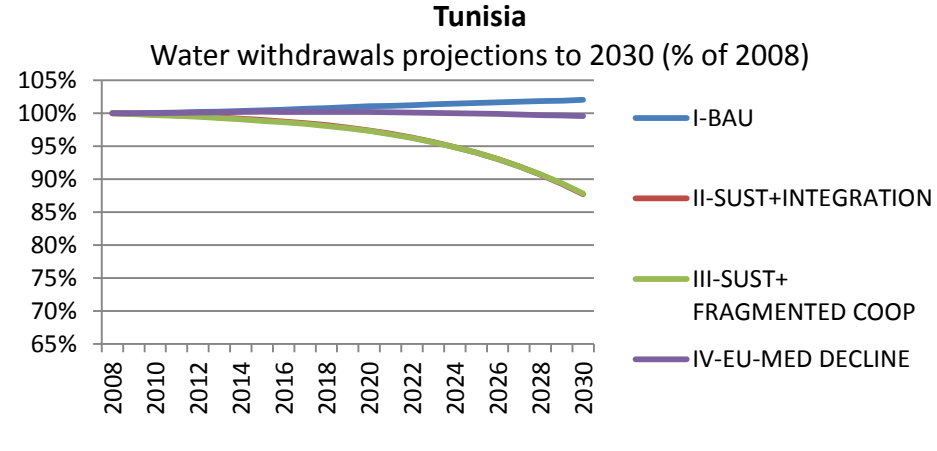
Ln(WWithdr)	Ln Water withdrawals (Km³)	Coef.	Std. Err.	t
Year	Technology Proxy	-0.01072	0.004938	-2.170
Irrigation Area	Ln (Irrigation Area squared) (10^3 ha)	0.37894	0.035031	10.820
GDP	GDP (million $)	8.93E-07	4.87E-07	1.830
Ln(Population)	Ln Population (million persons)	0.47202	0.230921	2.040
Imports cereals	Imports of Cereals (Tonnes)	1.80E-07	5.85E-08	3.080
Imports V & F	Imports of Vegetables & Fruits (Tonnes)	-2.68E-07	1.99E-07	-1.350
Dummy2 (Egypt)	Dummy	0.44449	0.188700	2.360
Dummy3 (Israel)	Dummy	0.67916	0.315098	2.160
Dummy3 (Jordan)	Dummy	1.37476	0.378397	3.630
Dummy4 (Lebanon)	Dummy	1.34488	0.401725	3.350
Dummy5 (Libya)	Dummy	0.74857	0.366288	2.040
Dummy6 (Morocco)	Dummy	0.03110	0.093822	0.330
Dummy7 (Syria)	Dummy	0.54806	0.183348	2.990
Dummy8 (Tunisia)	Dummy	0.27790	0.243100	1.140
Dummy9 (Turkey)	Dummy	-0.38327	0.223519	-1.710
Constant	Constant Term	16.77451	9.195276	1.820

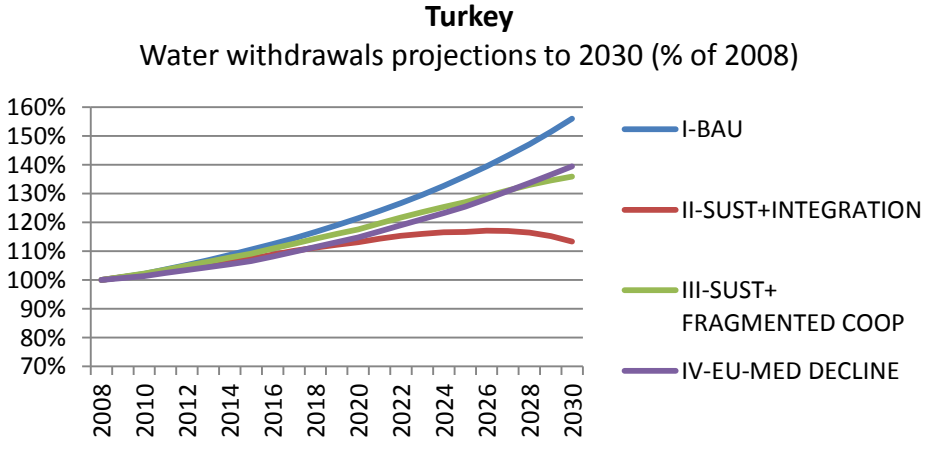
$R^2 = 0.98$

Projections of water withdrawals in the MED11 countries (selection)





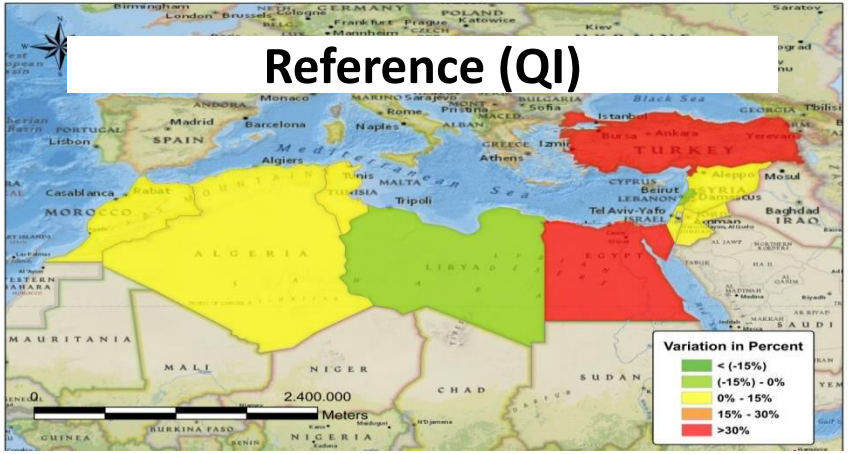




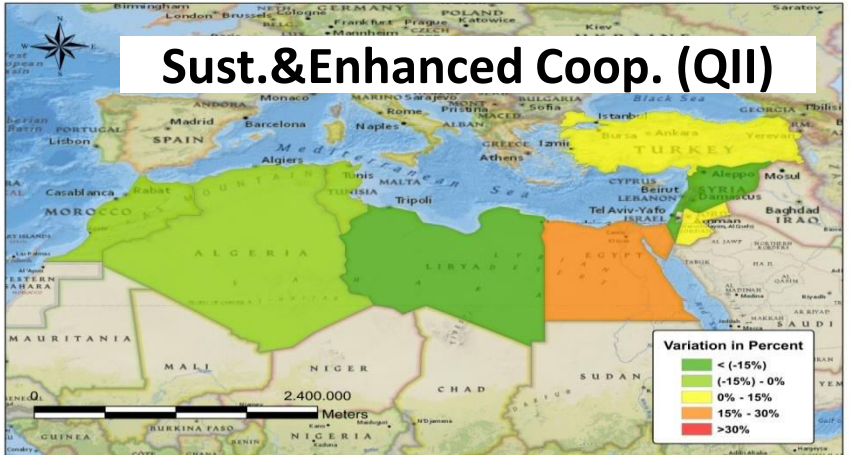
Water withdrawals in the MED11 countries

(2030 relative to 2008)

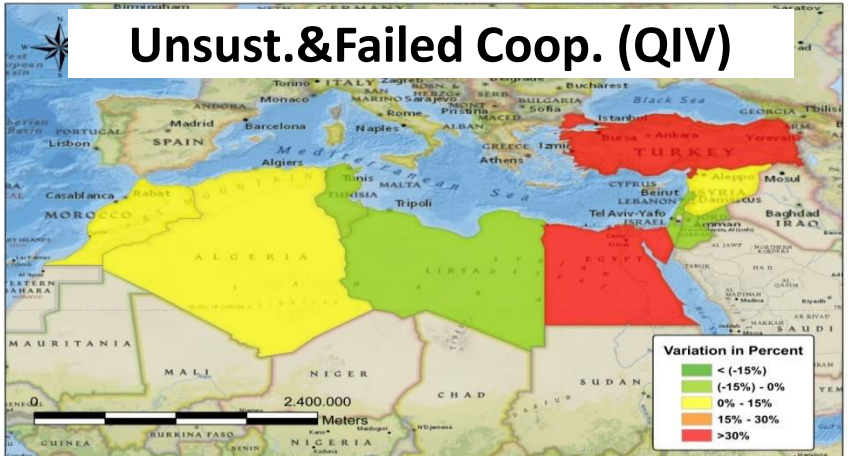
Reference (QI)



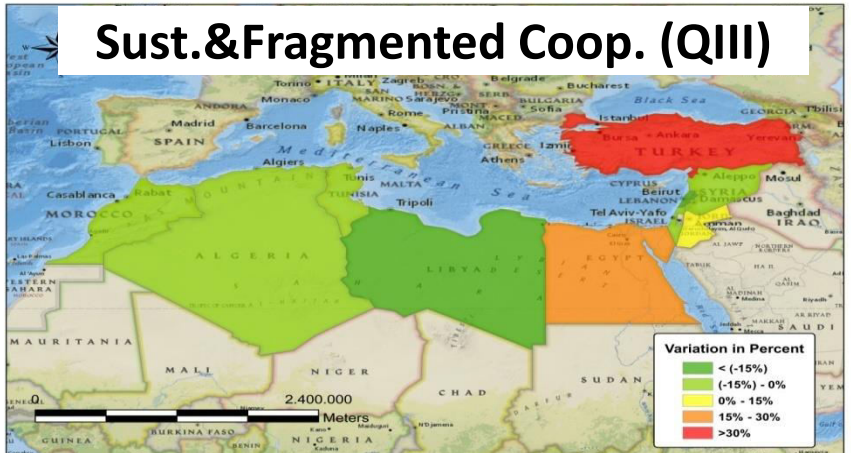
Sust.&Enhanced Coop. (QII)



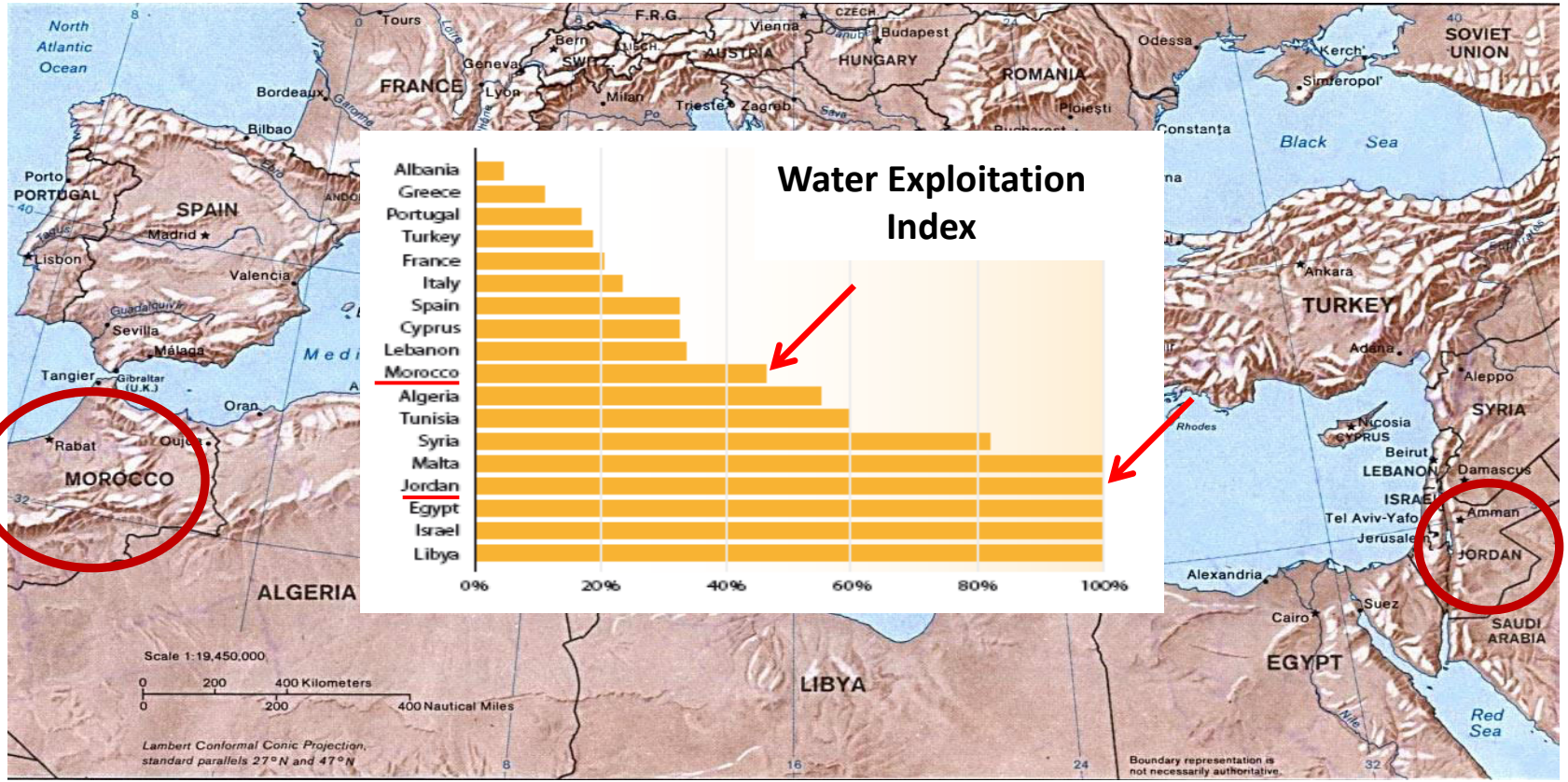
Unsust.&Failed Coop. (QIV)



Sust.&Fragmented Coop. (QIII)

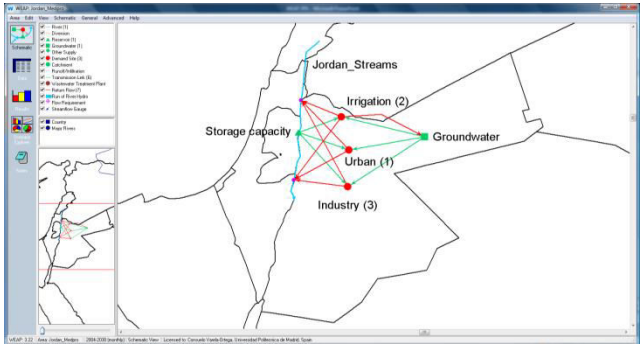


Country level analysis

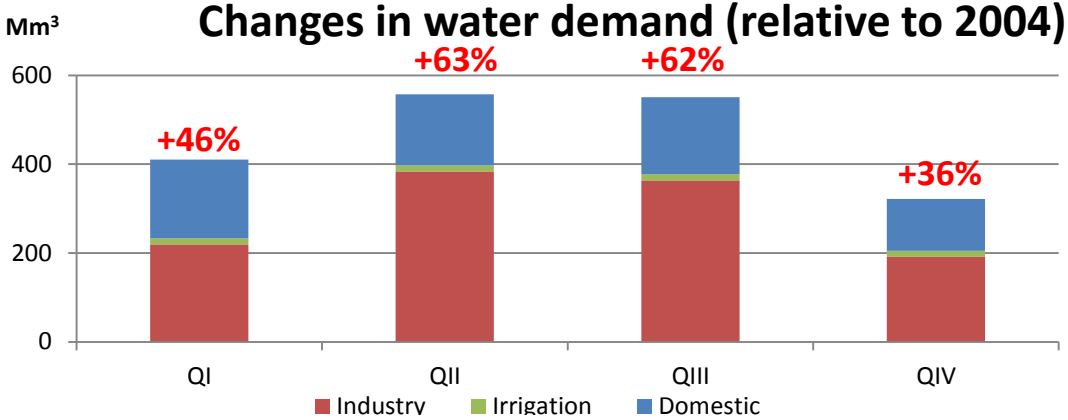


Hydrologic model scenario simulation: JORDAN

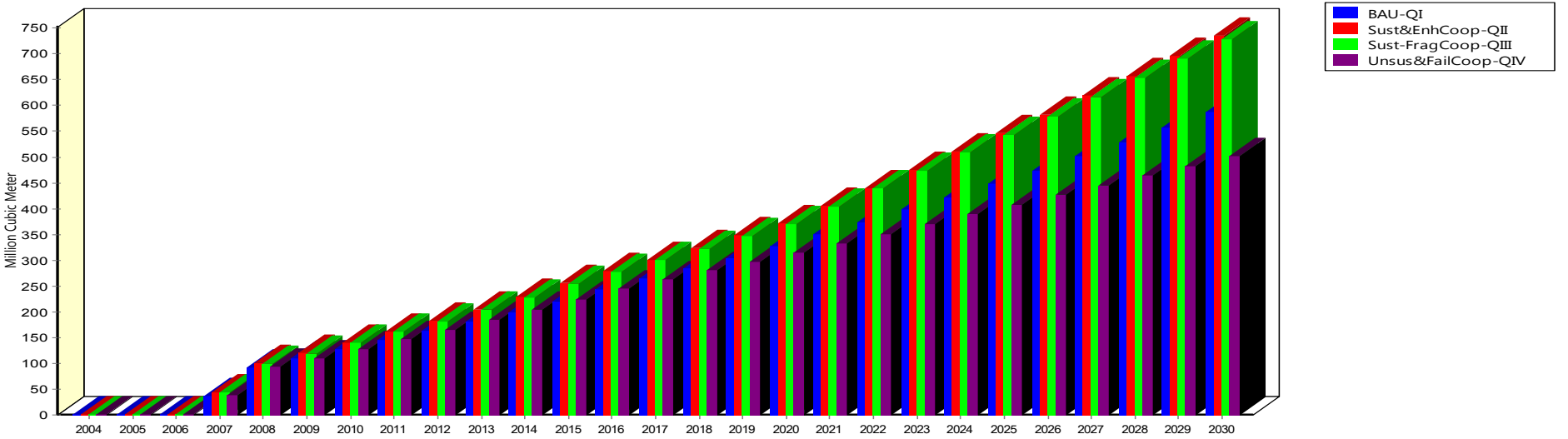
Jordan-Weap layout



Changes in water demand (relative to 2004)

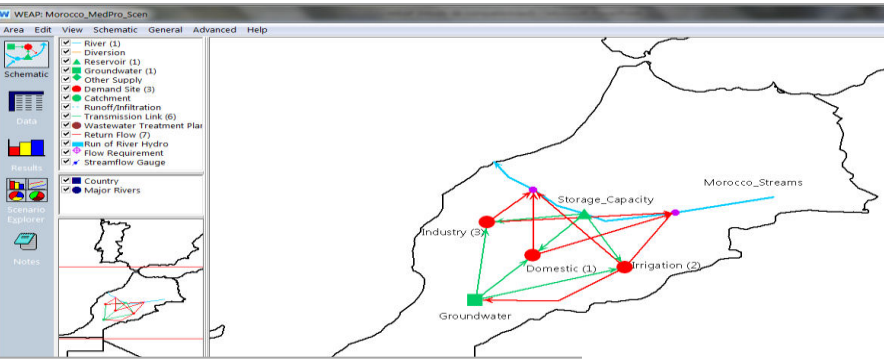


Unmet Demand

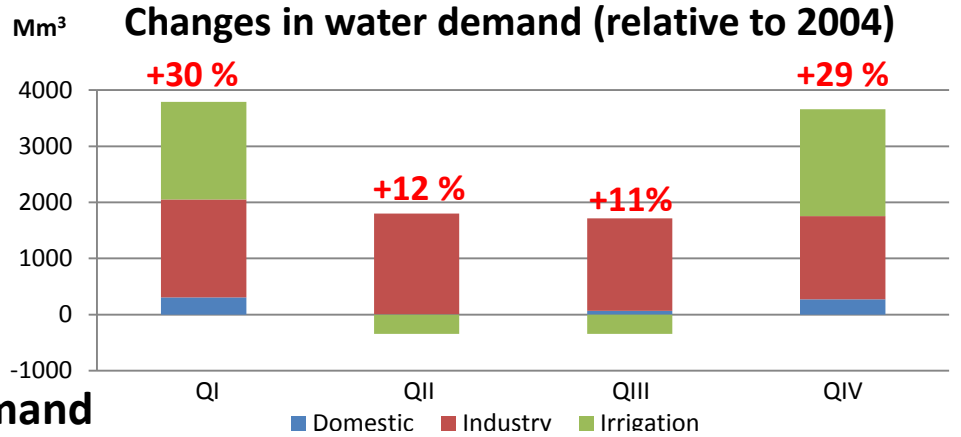


Hydrologic model scenario simulation: MOROCCO

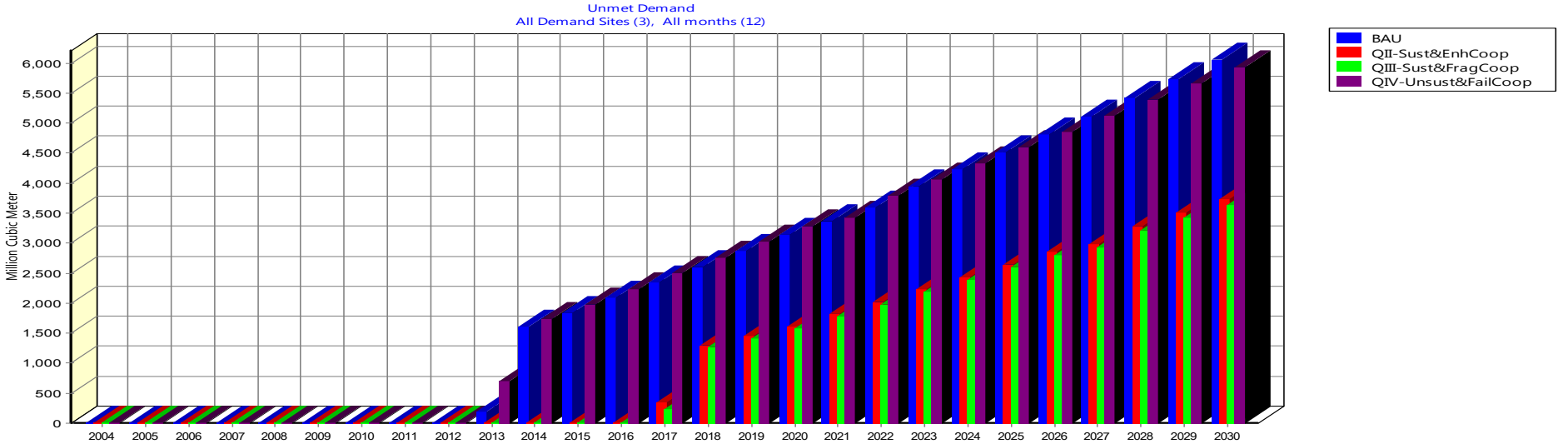
Morocco-Weap layout



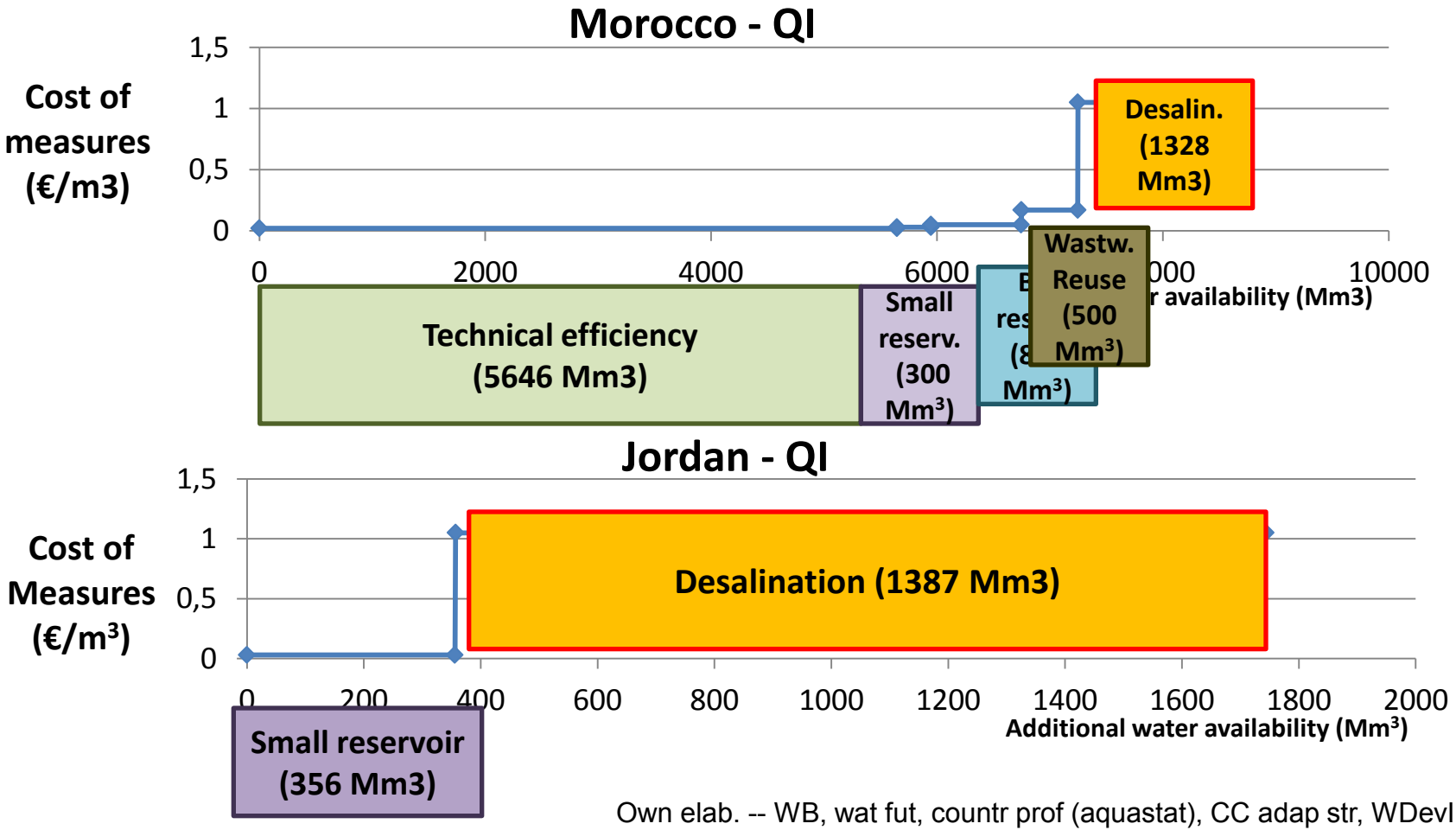
Changes in water demand (relative to 2004)



Unmet Demand



Closing the gap between supply and demand

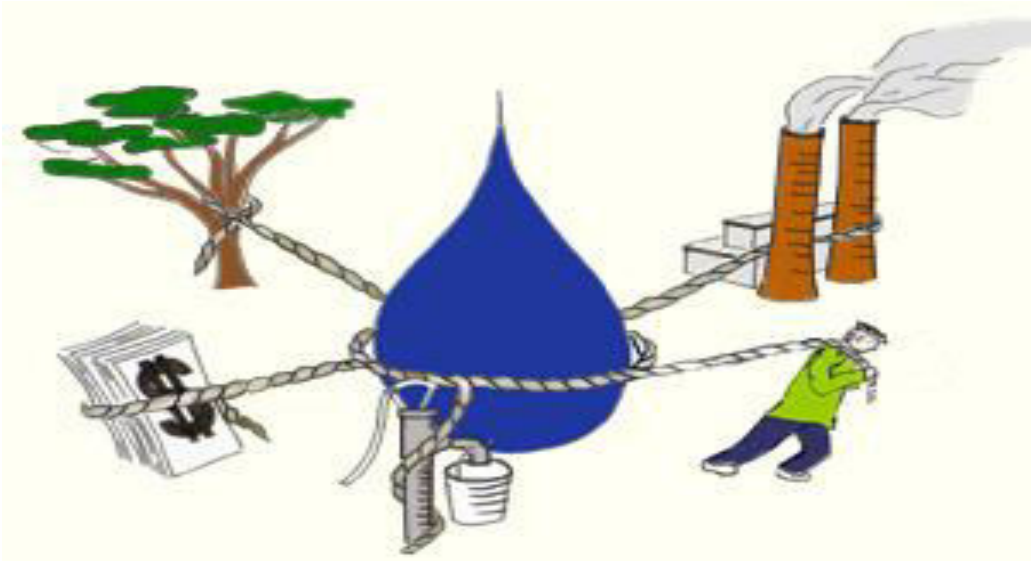


Own elab. -- WB, wat fut, countr prof (aquastat), CC adap str, WDevIn..

Conclusions and policy implications

- **An integrated vision** is needed to analyze the water and agricultural sectors in the Mediterranean: technical and agronomic drivers are not sufficient to derive policy considerations and **economic, social & institutional factors** have to be considered
- **Water abstractions to 2030 tend to stabilize** along the second half of the period as **irrigation expansion can reach its surface limit** and prevent further increases in most countries
- **More sustainable scenarios mitigate water withdrawal in all countries**, in spite of greater economic growth and trade, due to improved technical efficiency , better governance and active demand-side policies
- **At country level:** Closing the gap between water demand and supply requires a combination of measures (hard and soft). Sustainability scenarios rely on less costly demand-side soft measures

THAN YOU FOR YOUR ATTENTION



Source: FAO

Economic model scenario simulation

FARM GROSS MARGIN