Venice, 13-14 October 2011

Meeting of the EC Expert group on Water Scarcity and Drought

DSIRR2 a simulation tool for economic and environmental analysis of water use in agriculture

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OUTLINE

1) presentation of the tool

2) a case study:
unexpected water shortage in July
in the Trebbia Basin (North Italy)

DSIRR: DS for IRRigated agriculture

A SIMULATION TOOL

to share data and information
to generate and explore alternatives
to construct a shared view of the problem

The tool uses data and models
provides a graphical interface
can incorporate the decision makers' own insights

SUPPORT PARTICIPATORY BASIN PLAN IMPLEMENTATION

ADDRESS SPECIFIC ISSUES
LIKE WATER SCARSITY AND DROUGHT

A SCENARIO MANAGER FOR AGRO-ECONOMIC MODELS

AGRONOMIC ASPECTS → irrigation technology
water requirement by period
water-yield function

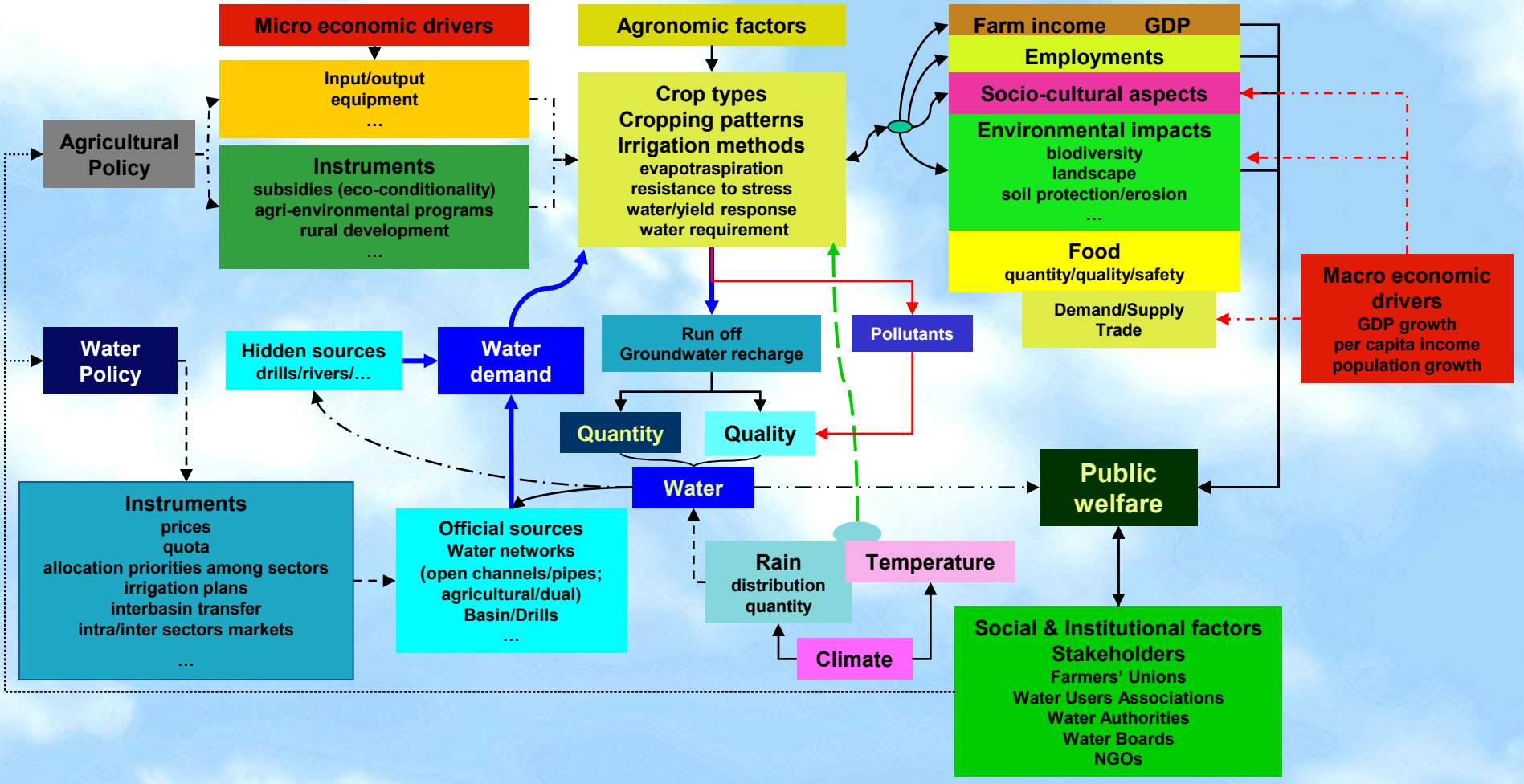
SOIL → relation with water use

WATER → Irrigation Boards and Authorities
water availability by source and period
irrigation network, rights, allocation, tariff and cost, …

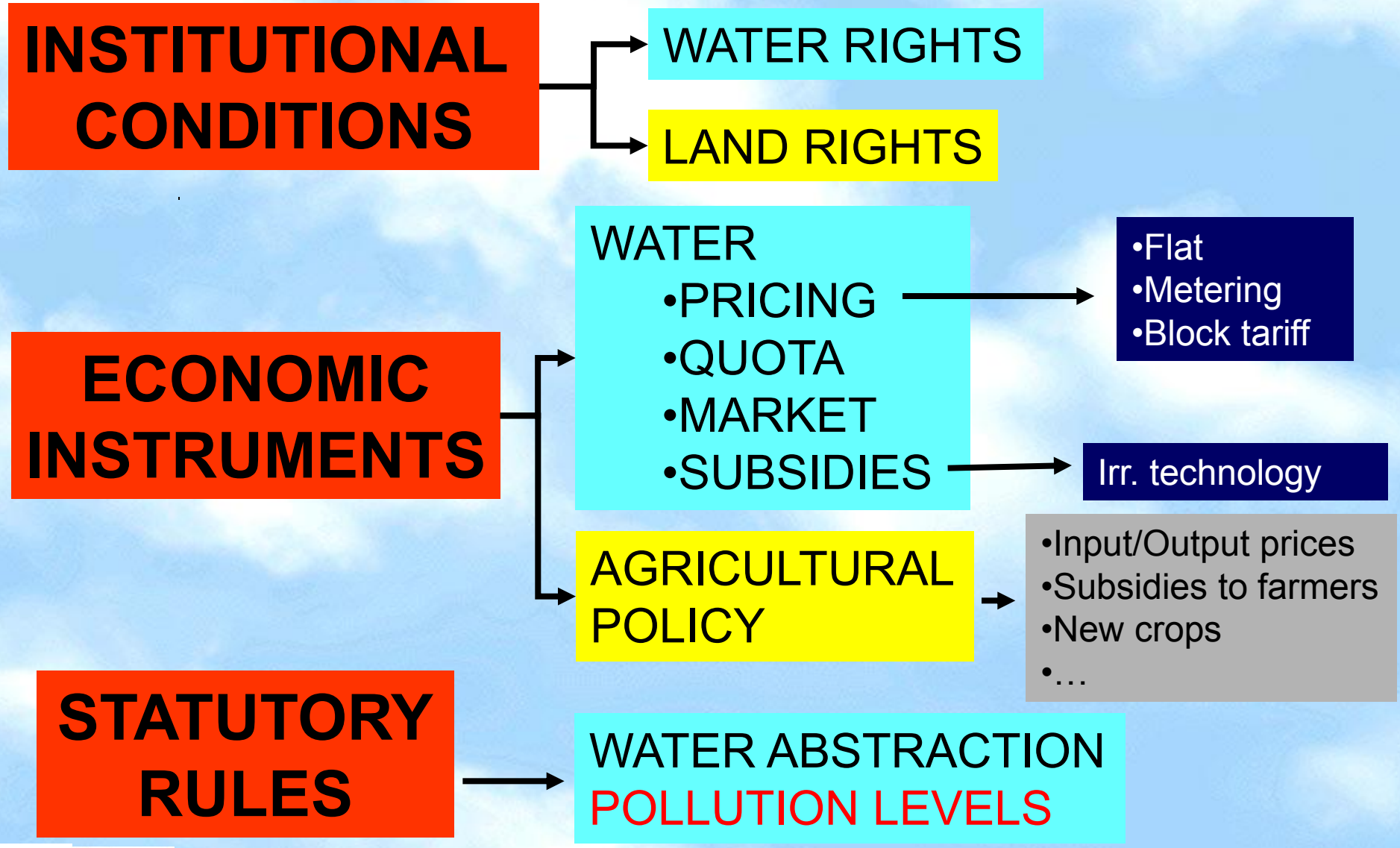
CLIMATE → rain quantity and distribution
temperature

ECONOMIC THEORY → mathematical programming models
simulate farmers' decision process

THE CONCEPTUAL MODEL OF WATER USE IN AGRICULTURE OF THE TOOL

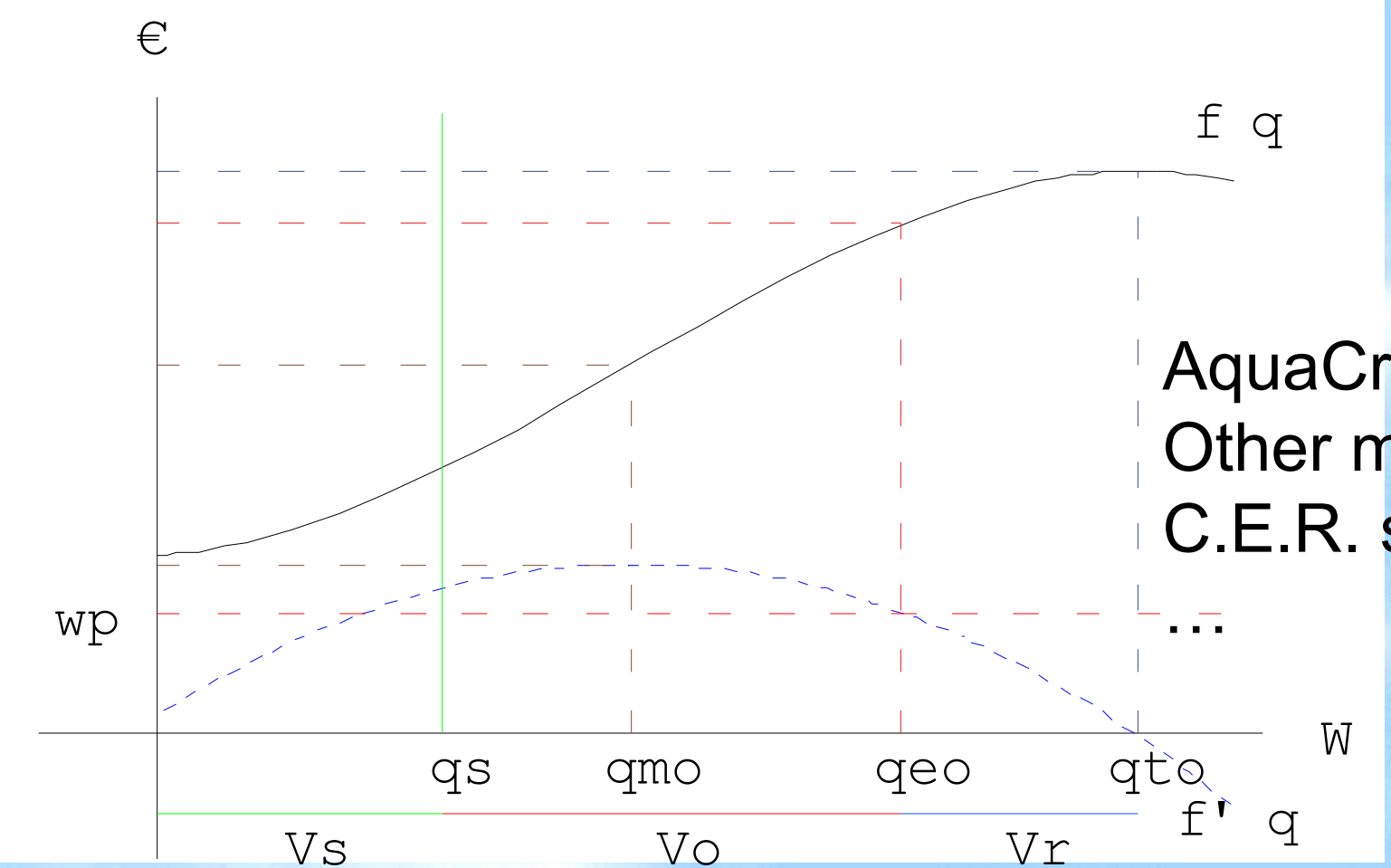


POLICY INSTRUMENTS SIMULATED



LINKING
AGRONOMIC - ECONOMIC MODELS

Water-Yield function (by crop)



AquaCrop FAO
Other models
C.E.R. studies
...

SCALE: HIERARCHICAL DECOMPOSITION

Macro

Basin

Sub-basins

Water Agencies
Irrigation Board

Production systems

annual crops, perennial crops, ...

Representative production units:

- main production: cereal, industrial, fruit, …
- management: family / no-family
- size: small / medium / large
- farmers' preferences
- …

Micro

THE MODELLING PROCESS

1. **Basin decomposition - Hierarchy construction**
2. **Mathematical models set up**

a) Farm

Homogeneous production units - Representative farms

Data collection

Statistical data + survey + experts + stakeholders

Learning process

b) System

Allotment by WA, max. extraction by period, …

3. **Simulation – Scenario analysis**

SCENARIO ANALYSIS

- **WATER scenario**

Change in technological and physical structure of irrigation
in water availability by period, tariff, cost, management

- **AGRICULTURE scenario**

CAP / National policy
Markets
Technology

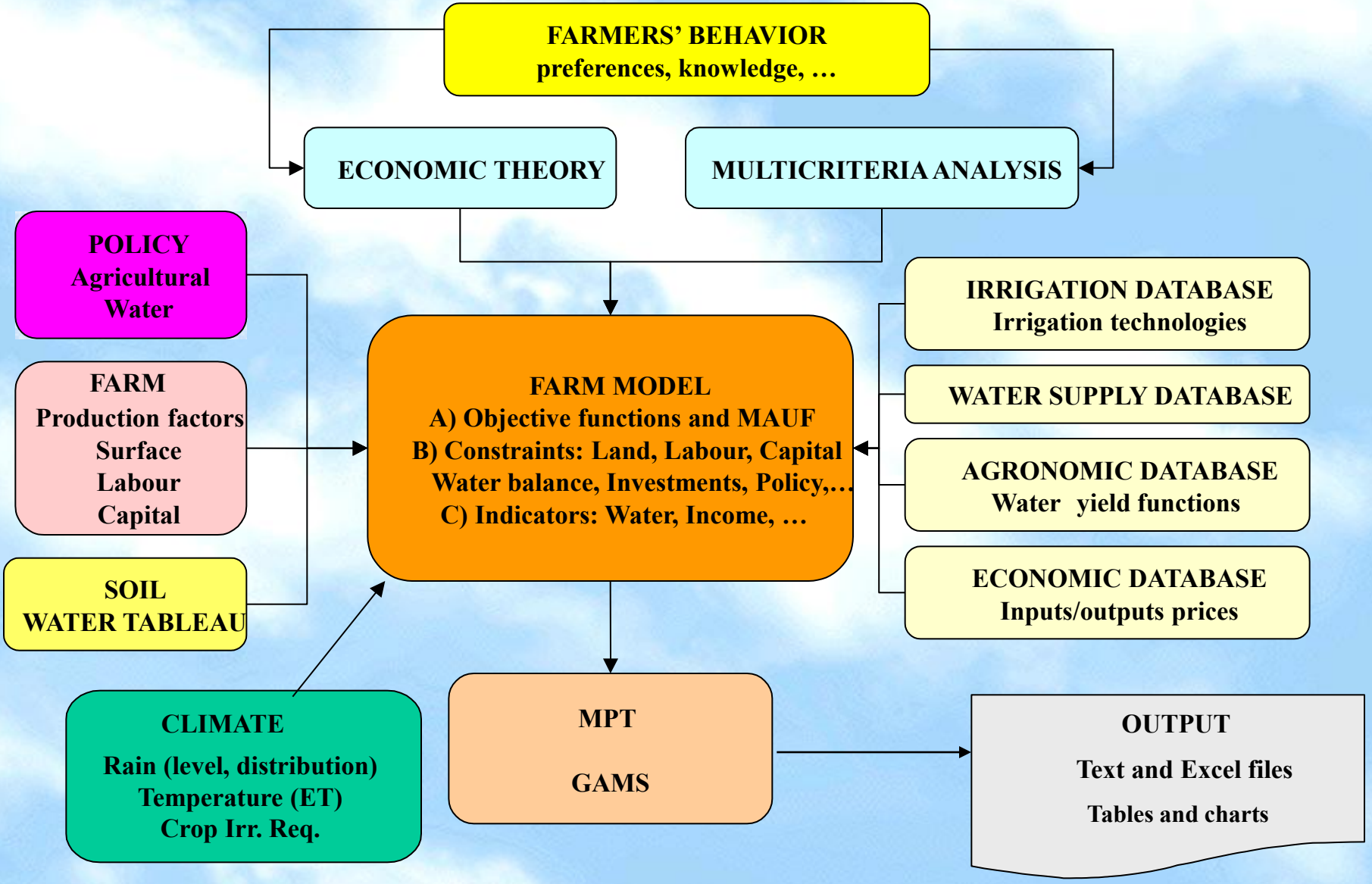
- **CLIMATE scenario**

INTEGRATION

Assess their **conjoint impacts**

Multidimensional indicators

THE FARM MODEL



INDICATORS

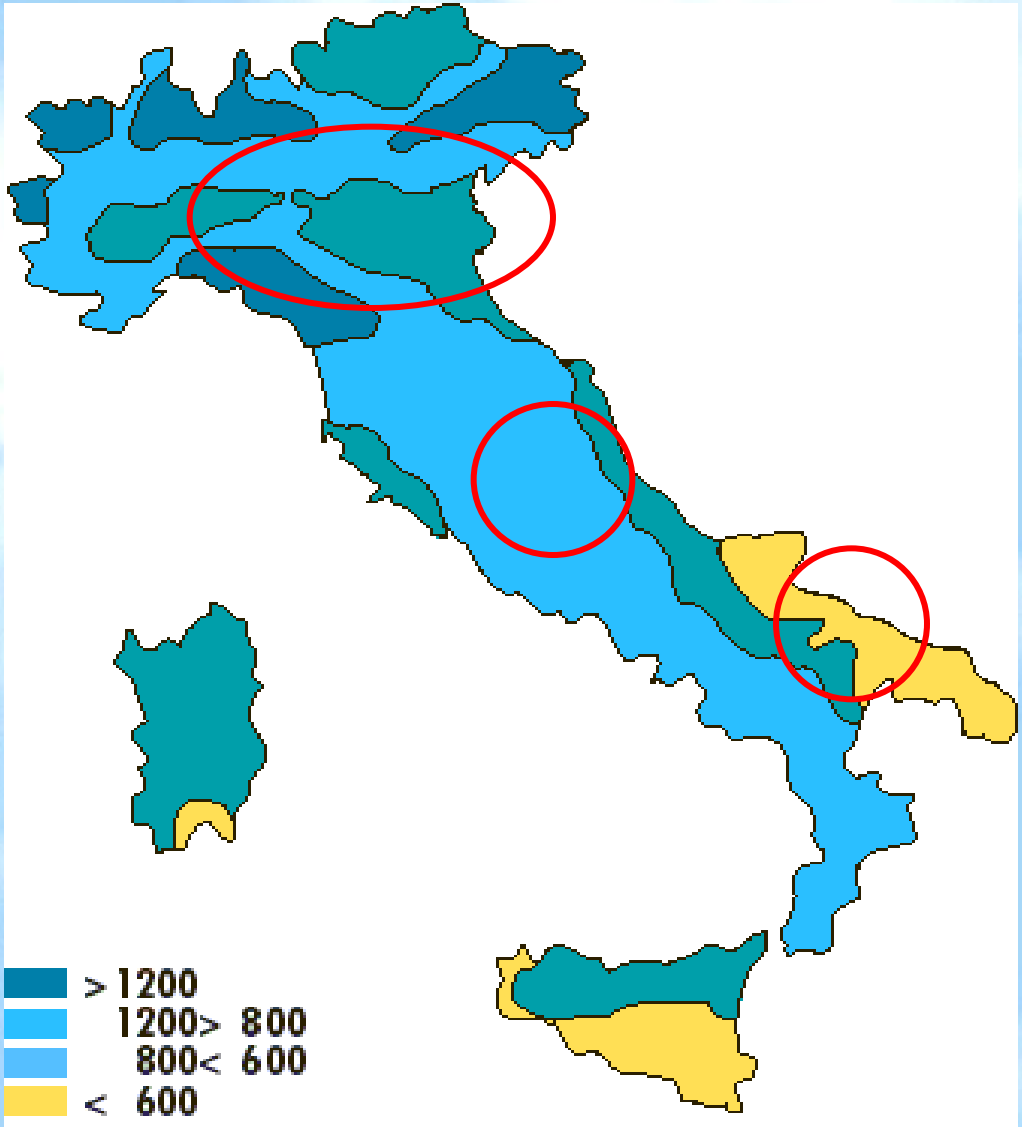
Area	Indicator
Economic	Farm income Agr. contribution to GDP Public support Marginal value of water
Social	Farm employment Labour seasonality
Landscape and biodiversity	Land use Soil cover
Water	Water used Irrigation technology
Nutrients and pollutants (pressure)	Nitrogen Pesticide Other chemicals

PREVIOUS STUDIES IN ITALY

Sustainability of European Irrigated Agriculture under Water Framework Directive and Agenda 2000
WADI: EVK1-CT-2000-00057

Other National and EU projects

Studies for Irrigation Board (IB)



WATER SHORTAGE IN THE TREBBIA BASIN

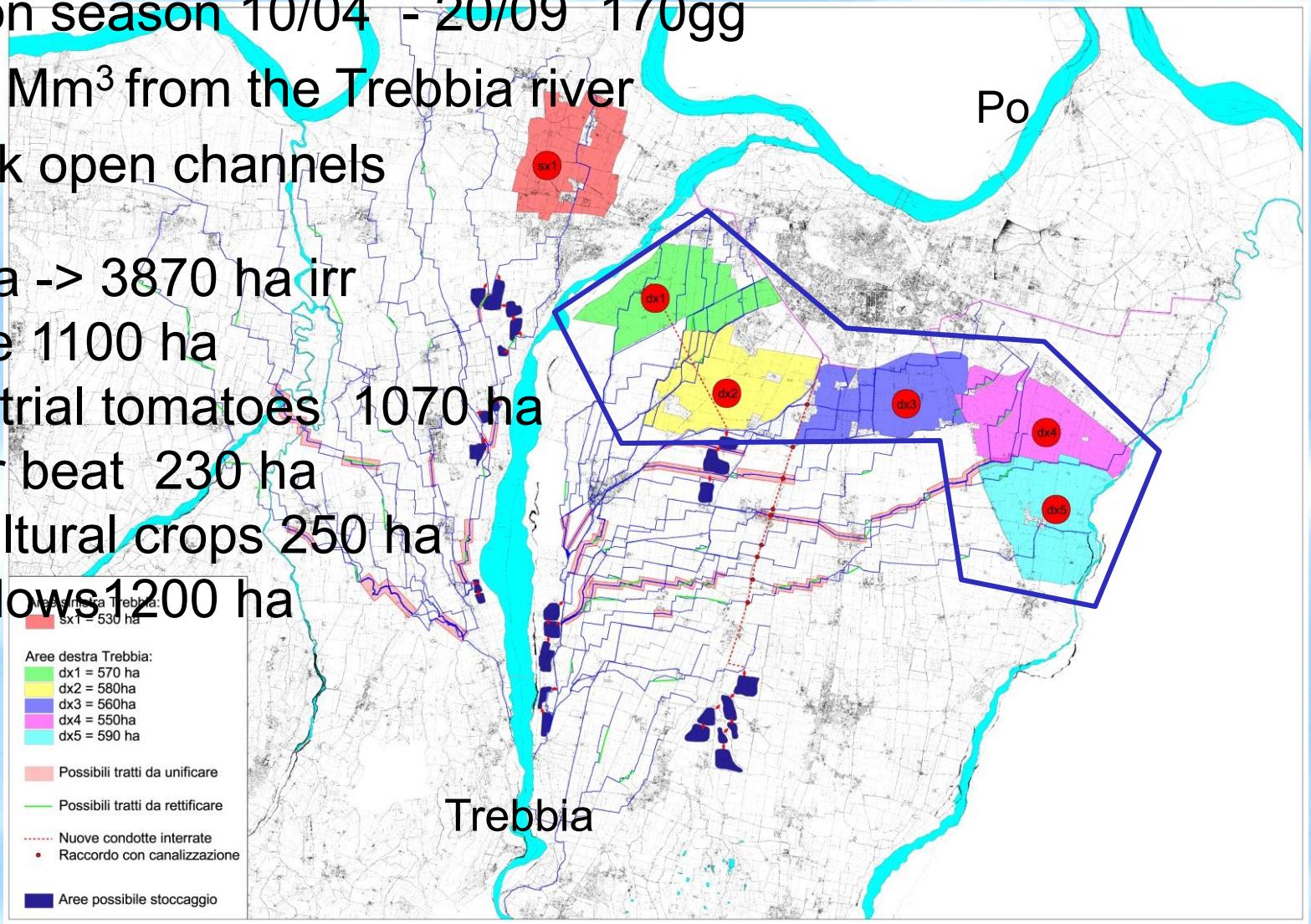
Irrigation season 10/04 - 20/09 170gg

36,981 Mm^3 from the Trebbia river

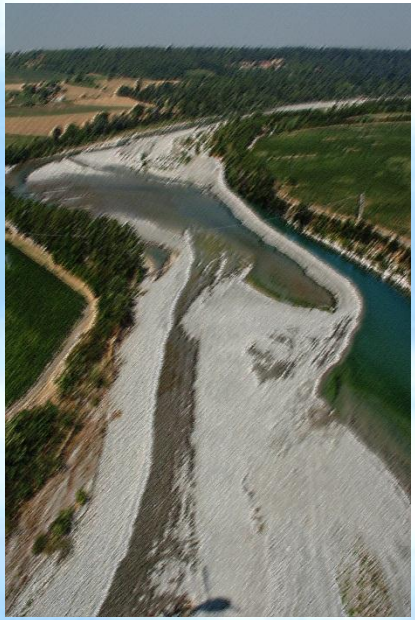
Network open channels

6320 ha -> 3870 ha irr

- maize 1100 ha
- industrial tomatoes 1070 ha
- sugar beat 230 ha
- orticultural crops 250 ha
- meadows1200 ha



IRRIGATION NETWORK IN THE TREBBIA BASIN



WATER BALANCE AND GROSS MARGIN

	m	1	2	3	4	5
EXTRA Q		X	X			
GM (000 Euro)		8.701	8.153	7.667	6.957	8.757
GMvar (%)			-6,30	-11,88	-20,04	0,64
WATER IBPC (Mm^3)		36.981	36.981	33.072	32.374	33.072
EFFICIENCY (%)		0,33	0,33	0,33	0,33	**0,50**
DISTRIBUTED (Mm^3)		12.204	12.204	10.914	10.683	16.536
IBPC	4	218	218	218	218	331
	5	1.528	1.528	1.528	1.528	2.044
	6	2.838	2.838	2.838	2.838	4.299
	7	4.013	4.013	3.492	2.794	5.292
	8	3.388	3.388	2.619	2.619	3.813
	9	101	98	95	92	101
	TOT.	12.086	12.083	10.791	10.089	15.880
OTHER SURFACE WATER (Mm^3)	TOT.	683	683	683	683	550
DEEP WATER (Mm^3)	4	246	246	246	246	134
	5	450	450	450	450	
	6	2.942	2.942	2.942	2.942	1.480
	7	4.142	3.408	3.413	3.420	2.864
	8	358	181	839	715	
	TOT.	8.138	7.227	7.890	7.773	4.478
D (Mm^3)		20.908	20.908	20.908	20.908	20.908
TOTAL WATER USE (Mm^3)		**20.908**	**19.994**	**19.365**	**18.545**	**20.908**
WATER DEFICIT (Mm^3)	**.**		**914**	**1.543**	**2.362**	

GROSS MARGIN BY PRODUCTION SYSTEM (Euro/ha)

		1	2	3	4	5
Ind. tomatoes	Irr	2.574	2.370	2.209	1.984	2.585
Orticoltural crops	Irr	5.554	4.914	4.398	3.671	5.565
Maize	Irr	1.246	1.059	904	688	1.261
Industrial crops	Irr	1.134	996	878	708	1.147
High value crops	Irr	8.662	8.662	8.656	8.655	8.675
Meadows	Irr	798	735	677	581	816
Mix crops	Rain	710	710	710	710	710
Mix crops	Irr	1.975	1.876	1.767	1.603	1.988

SHORT TERM WATER SHADOW PRICES (Euro/m³)

		2	3	4
Gossolengo	Ind. tomatoes	1,249	1,413	1,535
	Orticoltural crops	5,211	5,881	6,384
	Maize	0,647	0,733	0,798
	Industrial crops	0,647	0,733	0,798
	Meadows	0,325	0,375	0,426
	Mix crops	0,586	0,788	0,894
Piacenza	Ind. tomatoes	1,423	1,609	1,748
	Orticoltural crops	5,923	6,684	7,255
	Maize	0,739	0,837	0,91
	Industrial crops	0,739	0,837	0,91
	Meadows	0,373	0,53	0,9
	Mix crops	0,837	0,91	0,984
Podenzano	Ind. tomatoes	1,488	1,682	1,828
	Orticoltural crops	6,191	6,987	7,583
	Maize	0,773	0,876	0,953
	Industrial crops	0,876	0,953	1,004
	Meadows	0,449	0,555	0,586
	Mix crops	0,953	1,161	1,488

KEY MESSAGES FROM THE CASE STUDY

In the last 10 years: water demand do not decrease – cultivated land yes

irrigated agriculture: higher profitability and water requirements due to climate change

Water a strategic input for agriculture also in the future

Strong economic impact of unexpected water shortage in July

1 m^3 of water -> reduction 0,6 Euro GM

Different water shadow prices among production units reallocation – rights transfer

Strong substitution among sources (surface / deep water)

environmental regulation protecting the river

negative impact on water tableau - difficulties of monitoring and enforcing policies

Irrigation Board plays a central role Local Authority connecting farmers

Pricing policy open channel – no metering – high cost to transform - uneffective

Management measures water scheduling – reallocation – farmer education

Infrastructural measures water network efficiency – small local basin – reuse
irrigation technologies – information services

FINAL COMMENTS
to properly address water shortage and scarcity in agriculture

Agriculture is not homogeneus even in a small region and is quickly changing (future different from the past) – local studies are needed

Water use depends from many distinct aspects at different scales

Uncertainty is increasing

An integrated partecipatory approach is requested

Mix of measures: demand - supply / infrastructure - management

Modelling can support the process

FINAL COMMENTS ON THE TOOL

Limits

Agriculture only, other sectors could be included

Requires a lot of expertises to be properly used

Advantages

Integration of agronomic-economic-hydraulic knowledge with climate and policy (agricultural and water)

Multi scale

Multidimensional assessment: socio-economic and environmental indicators

Flexibility, Transparency, Replicability, Accessibility, Modularity

Thank you for your attention

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