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DSIRR
A DSS FOR AN ECONOMIC AND ENVIRONMENTAL ANALYSIS OF IRRIGATION

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DSIRR

Decision Support tool for Irrigation

A scenario manager for agro-economic models

The present beta non commercial version operates as a 32 bit Windows application on a PC with at least 32 MB of RAM

The code is written in Visual Basic
The program requires GAMS package installed on the PC

In most countries agriculture represents the higher percentage of water demand (60-80%)

Many experts suggest to reduce this amount via economic instruments

In this direction moves also the EU Water Framework Directive 60/2000 (WFD) defining criteria for water management, regulation and pricing

Water Framework Directive (60/2000)

	Purposes
Goal: Environmental sustainability	Achievement of a “good environmental status”
Principles and instruments	Adoption of the **Polluter Pays Principle (PPP)** and **User Pays Priciple (UPP)** **Economic instruments are recommended to provide users with adequate incentives for sustainable use**
From supply expansion to demand control	Consideration of the economical and social constraints to expanding demand and possibly to evaluate the opportunity of adopting **resource saving** measures
Adequate financial resources	**Cost Recovery (art. 9)** to ensure that utilities dispose of adequate financial resources in order to sustain the costs even with a **decreasing role of the public sector**

WFD

Implementation at catchment scale

↓

Definition of river basin plans

↓

**Long term forecasts
of supply and demand for water**

What happens if …

in the agricultural sector
Market (input/output prices)
Policy (subsidies, constraints,…) change
Technologies (innovation)

Water regulation and
economic instruments change
(institutions, rights,
prices, tariffs, quota,…,)

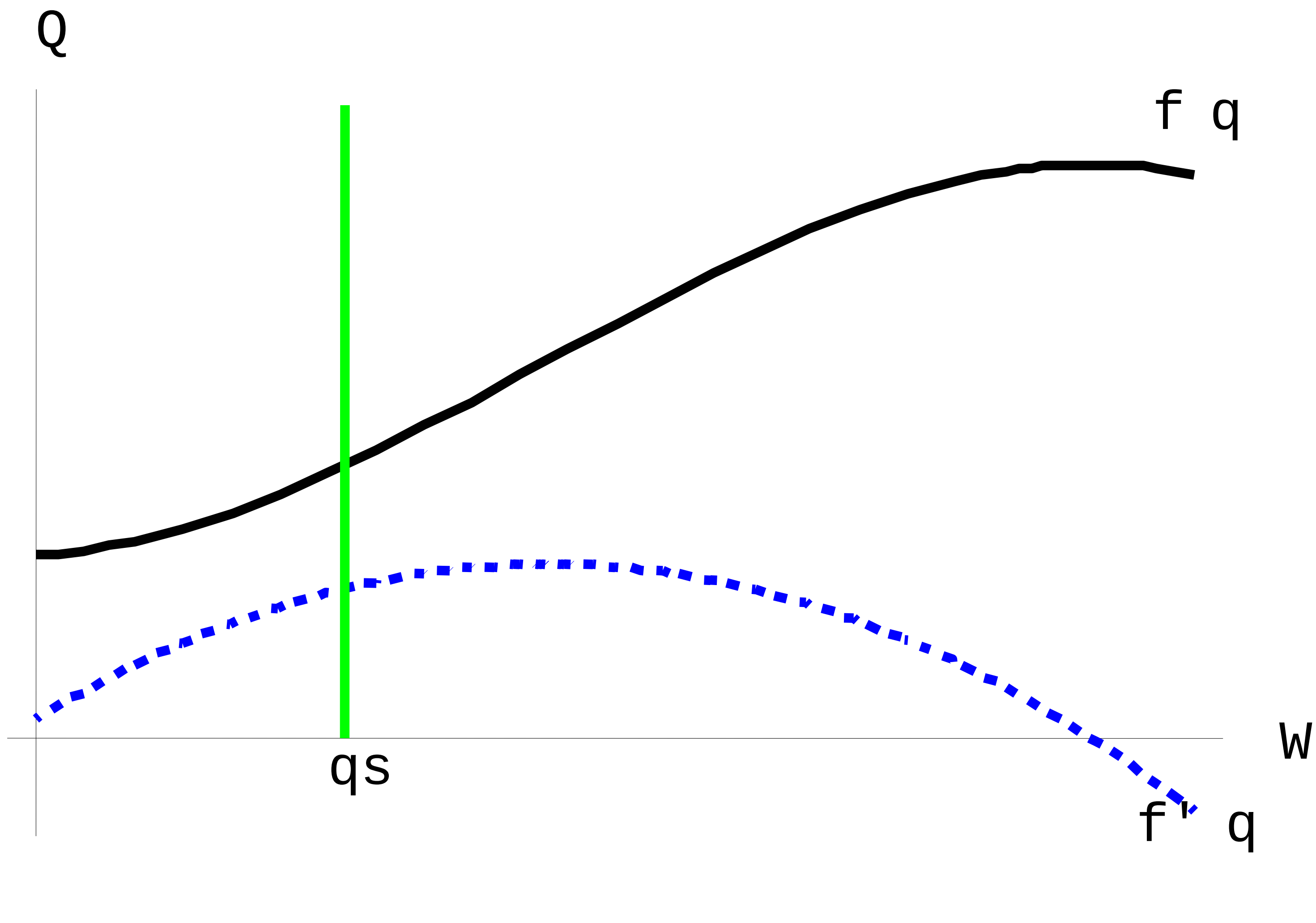
The European
"Common Agricultural Policy" (CAP)

- It is undergoing a widespread reform (Agenda 2000 - Mid Term Review)
  - not motivated by environmental reasons
- CAP does not give up the policy objective of sustaining farmers' income
- support prices eliminated
- adopted direct income compensations
  - "decoupled" from commodities production - ecosussidiariety
    (support conditioned to good environmental practices)
  - recognition of positive environmental impacts (externalities)
  - promotion of quality

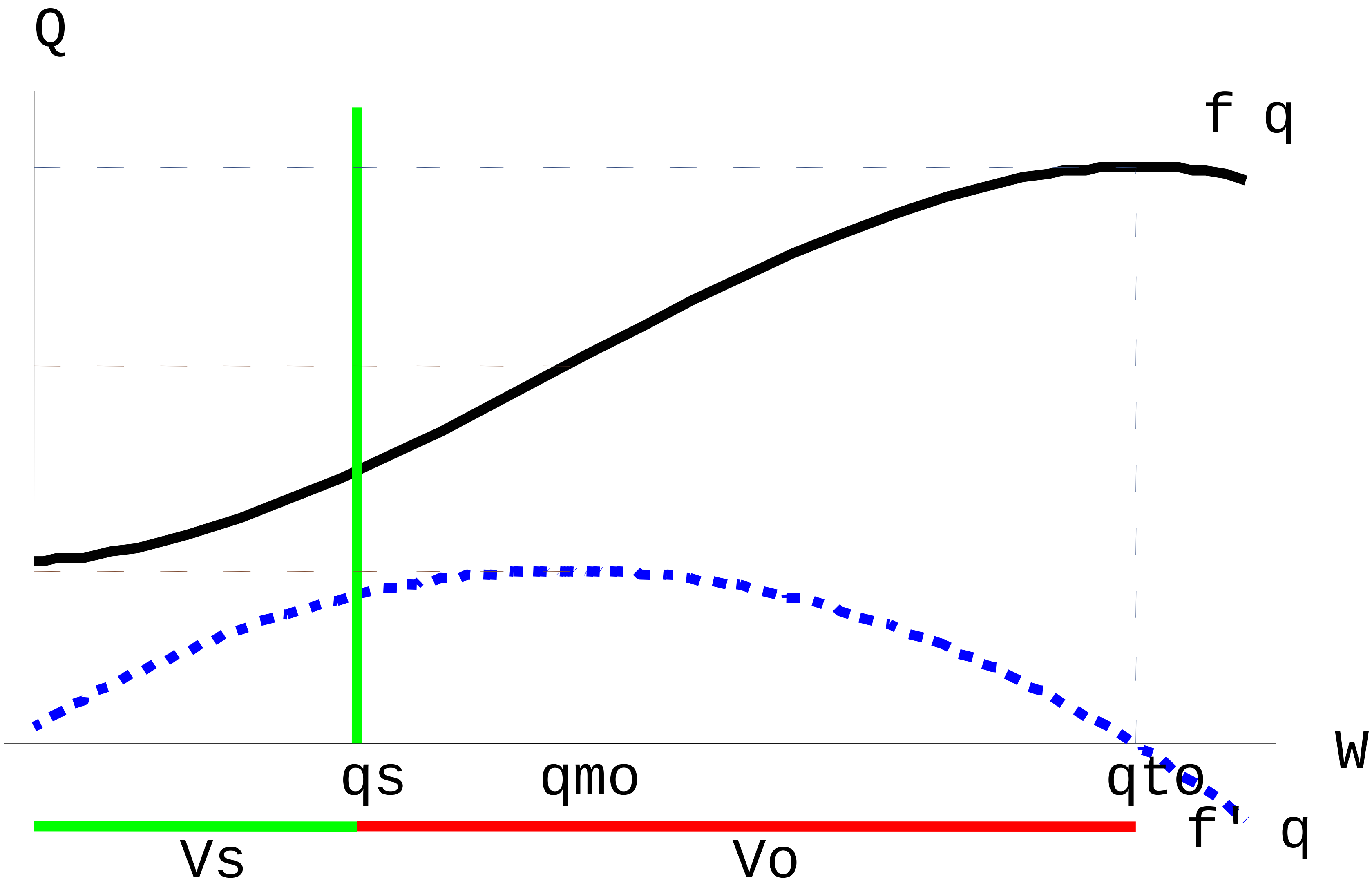
Irrigation
in an economic context

- **Water is an input / production factor**
  - Increase quantity
  - Improve quality
  - Reduce risk
    - Increase production set (new crops)
    - Reduce variation over time

Crop water yield function

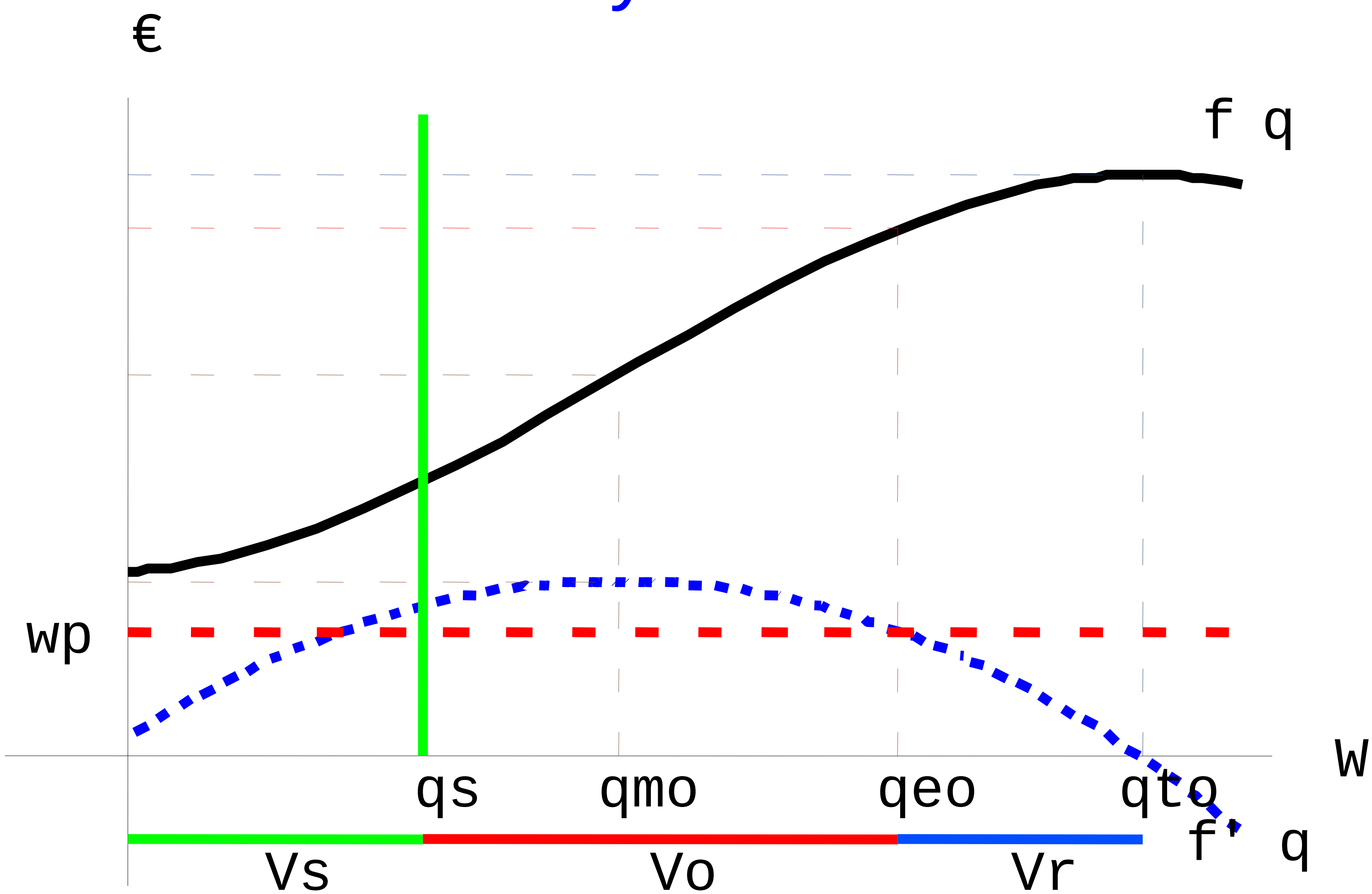


Technical optimun



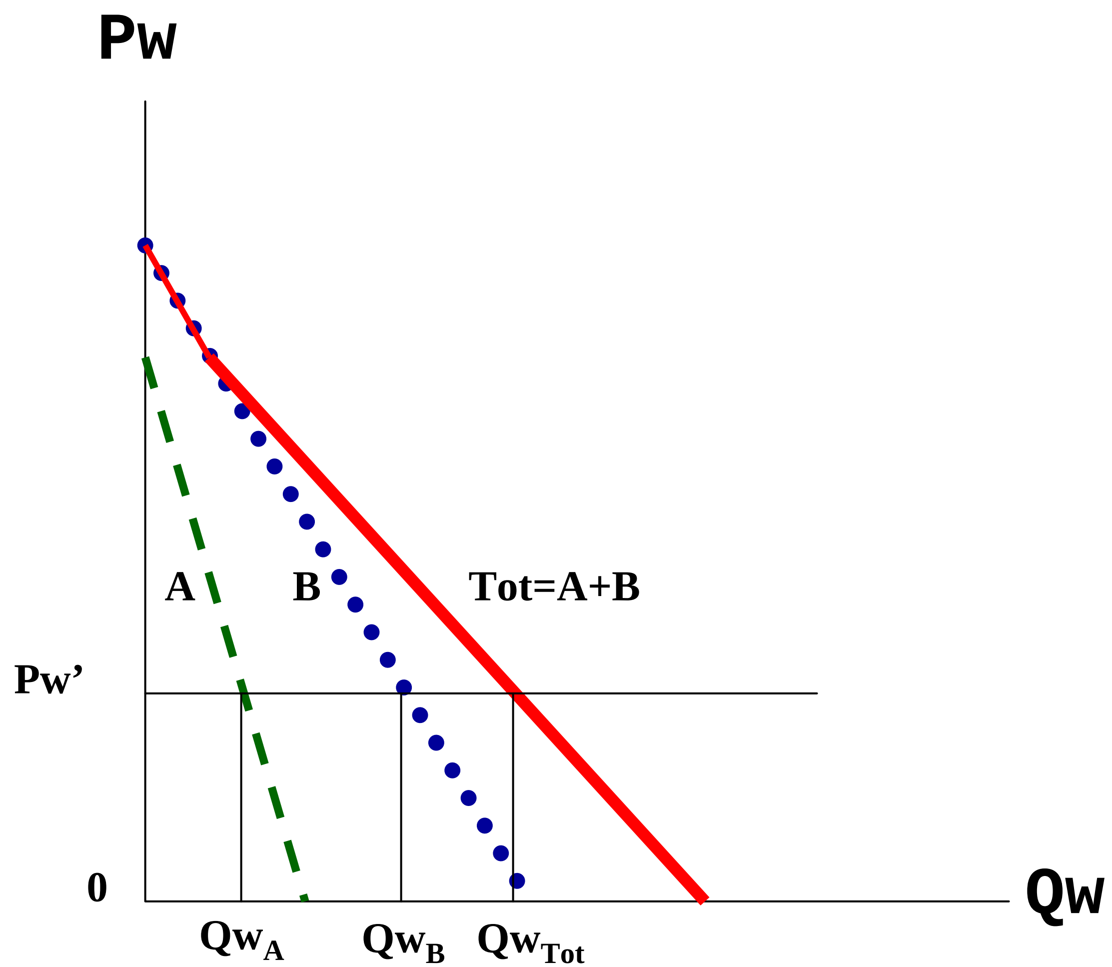
Economical optimun

water yield function

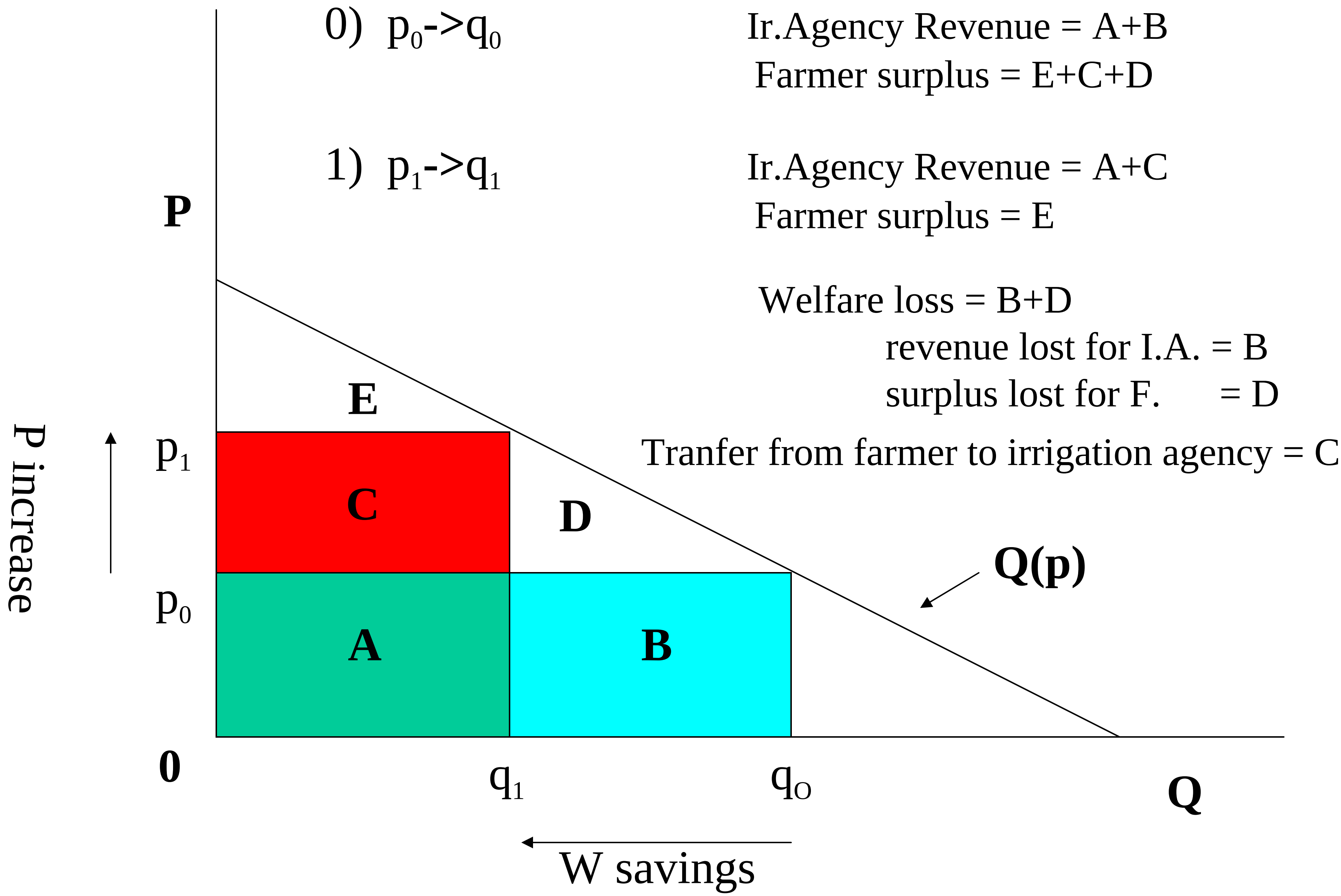


The demand curve

Many crops – many farms



A WATER PRICING POLICY MODEL



What are demand curves for ?

They permit to anticipate farmer behaviour supporting policy definition

Prices, subsidies, tax
in general all the market mechanisms
can be utilized

How can water demand curves be obtained ?

simulating farmers' behaviour

by mathematical models

The methodology (1)

In order to assess the policy impact on:

- **Water demand**
- **Farm income**
- **GDP contribution**
- **Employments**
- **Environmental Sustainability Indicators**

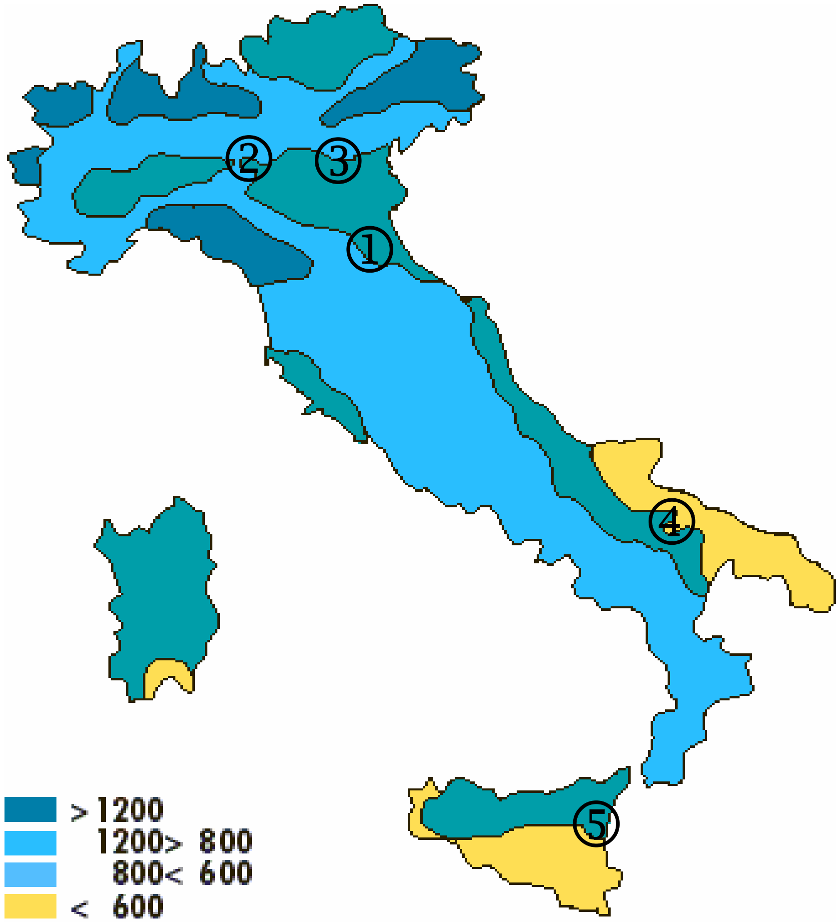
DSIRR considers
relevant agriculture systems (case-studies)

analysis is carried out via a
microeconomic technique based on
mathematical programming optimisation models

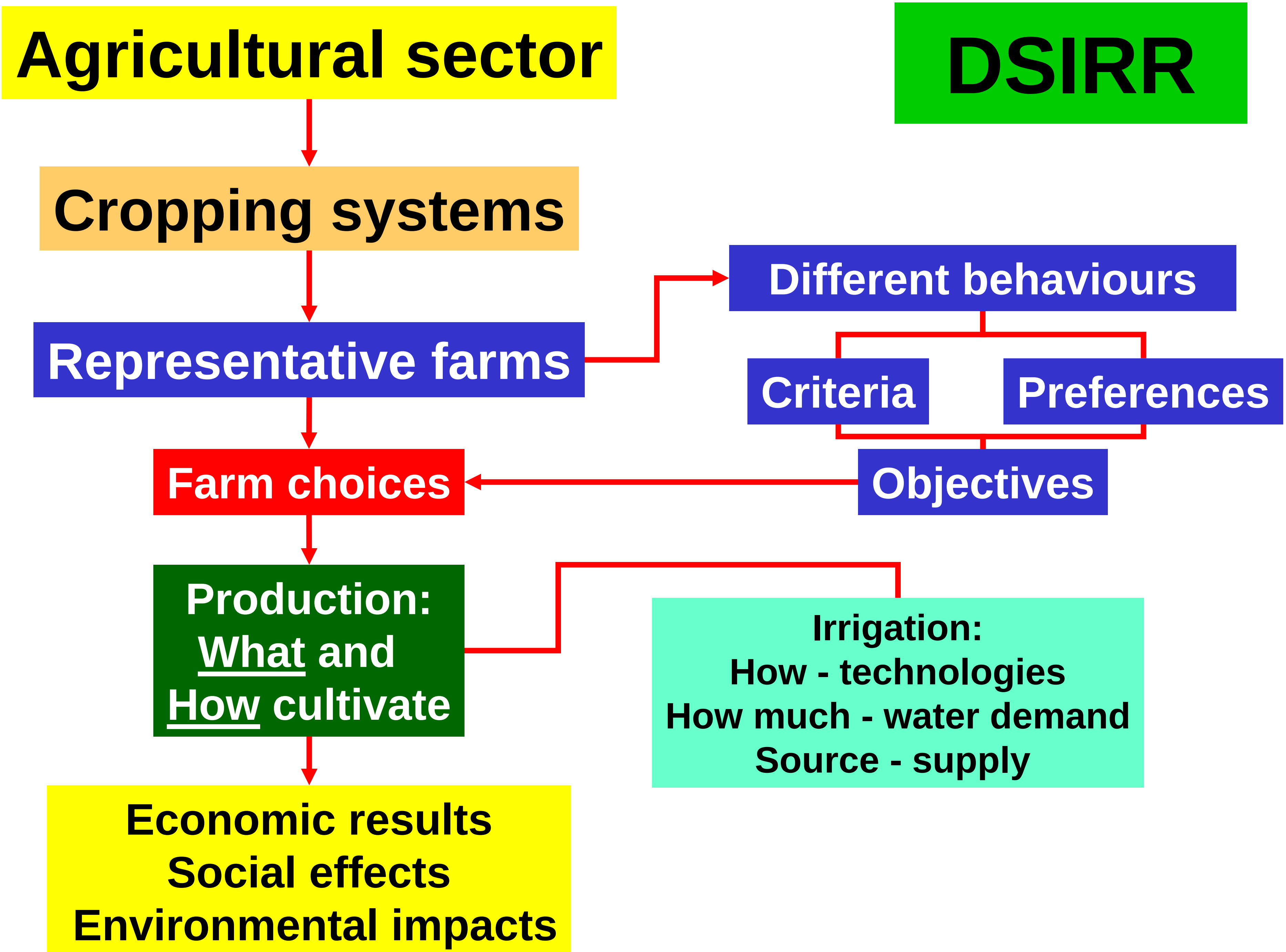
The methodology (2)

- Identification of the basin
  - Homogeneous production district
- Data collection - statistical data and ad hoc survey
  - Cropping systems
    - Crop mix
    - Production/irrigation technologies
    - ….
- Modelling
  - Calibration
  - Scenario Analysis (what-if)
- Results interpretation and policy recommendations

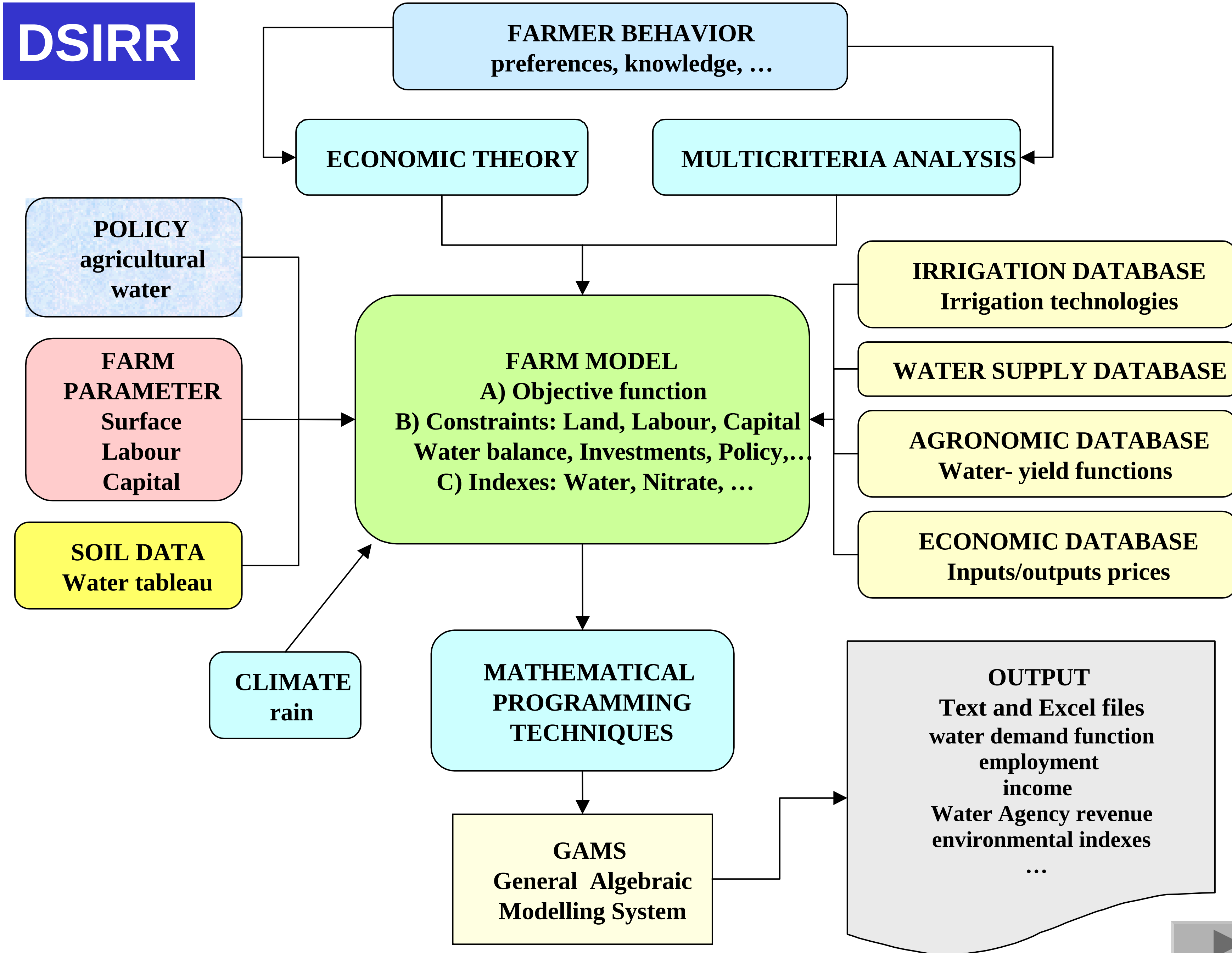
Location of case studies in Italy in EU WADI Project



① ***Fruit (perennial)***
② ***Cereal - industrial***
③ ***Rice***
④ ***Vegetables***
⑤ ***Citrus (perennial)***


Agricultural sector
DSIRR
Cropping systems
Different behaviours
Representative farms
Criteria
Preferences
Farm choices
Objectives
Production:
What and
How cultivate
Irrigation:
How - technologies
How much - water demand
Source - supply
Economic results
Social effects
Environmental impacts

DSIRR


FARMER BEHAVIOR
preferences, knowledge, …
ECONOMIC THEORY
MULTICRITERIA ANALYSIS
POLICY
agricultural
water
FARM
PARAMETER
Surface
Labour
Capital
SOIL DATA
Water tableau
FARM MODEL
A) Objective function
B) Constraints: Land, Labour, Capital
Water balance, Investments, Policy,…
C) Indexes: Water, Nitrate, …
IRRIGATION DATABASE
Irrigation technologies
WATER SUPPLY DATABASE
AGRONOMIC DATABASE
Water- yield functions
ECONOMIC DATABASE
Inputs/outputs prices
CLIMATE
rain
MATHEMATICAL
PROGRAMMING
TECHNIQUES
GAMS
General Algebraic
Modelling System
OUTPUT
Text and Excel files
water demand function
employment
income
Water Agency revenue
environmental indexes
…

Multiattribute analysis (1)

Multi Attribute Utility Theory (Romero et al.)

A set of possible attributes is defined (income, risk, labour, complexity, …)

Each attribute is defined as a function of the decisional variables X $f_i = f_i(x)$

$$U = \sum_{i=1}^{q} \frac{w_i}{k_i} f_i(x)$$

Where:
q number of relevant attributes
w objectives weights
f_i calculated value of attribute *j*
k_i normalizing factor

How to define *w* objectives relative importance ?

Multiattribute analysis (2)

1) The observed *fobs* values are quantified (given the existing crop mix)

2) The best pay-off matrix is quantified (2 stages)

f_{ij} the value of objective *i* when objective *j* is optimized

$$\sum_{j=1}^{q} w_j f_{ij} = fobs_i$$

3) Since an exact solution to the previous problem does not exist total standardized deviation are minimized (goal programming)

$$\min \sum_{j=1}^{q} \frac{n_i + p_i}{fobs_i}$$

$$s.c.$$

Where *n, p* negative and positive deviations

$$\sum_{j=1}^{q} w_j f_{ij} + n_i - p_i = fobs_i$$

			Time horizon	
	OBJECTIVE		Short	Long
INCOME	GROSS MARGIN	Ma	LP	
	NET INCOME/ PROFIT	Ma		MIP
RISK	E/V	mi	NLP	MINLP
	MOTAD	mi	LP	MIP
	MAX NEG. SEMIVAR	mi	LP	MIP
	TOTAL NEG. SEMIVAR.	mi	LP	MIP
	INC. CONCENTRATION	mi	LP	MIP
LABOUR	FAMILY	mi	LP	MIP
	HIRED	mi	LP	MIP
DIF	COMPLEXITY INDEX	mi	LP	MIP

Legend: Ma = maximizing, mi = minimizing
LP linear, NLP non linear, MIP integer, MINLP integer non linear programming model

Income definition and time horizon

In the short term

A) Gross output
Income
Subsidy
Other

B) Expenses [intermediate consumption]

Variable costs
Inputs
Services
Salary
Rent

C) A-B GROSS MARGIN

In the long term

D) Fixed costs
Asset Depreciation
Existing
New investments
Irrigation Fees

E) C-D NET INCOME

F) Remuneration
Own labour
Interest on asset
Own land

G) E-F PROFIT

The farm model (income objective)

$$\max_{\{X,W\}} \text{INC}=\sum_{c}\sum_{i}\sum_{s}\left\{X_{c,i,s}\left[p_{c,i}\,q_{c,i,s}\left(wr_{c,i,s}\right)+su_{c}-vc_{c,i,s}\right]\right\}-\sum_{k}\sum_{l}\sum_{p}W_{k,l,p}\,wp_{k,l,p}$$

s.c.

…

$$\sum_{s}\sum_{c}\sum_{i}X_{c,i,s}ir_{c,i,s}\leq\sum_{l}W_{k,l,p}\qquad\forall k,p$$

where:

c crop, *i* irrigation level, *s* type of soil, *k* water source, *l* water provision level, *p* period.

INC income (€), $X_{c,i,s}$ activities (ha), $p_{c,i}$ crop market price (€/t), $q_{c,i,s}(wr_{c,i,s})$ crop production as function of water (t), $wr_{c,i,s}$ crop water requirements (m^3), su_c subsidies (€), $vc_{c,i,s}$ variable costs (€), $W_{k,l,p}$ water consumption (m^3), $wp_{k,l,p}$ water price (€/m^3), $ir_{c,i,s}$ crop irrigation requirements (m^3)

			Time horizon	
			Short	Long
N. Ob.	1	Mono-objective	x	x
	> 1	MAUT	x	x
Decision variables	Farm	Enlargement / reduction	no	yes
	Crop	Annuals change mix	yes	yes
		Plantation abatement	yes	yes
		New plantation	no	yes
	Irrigation	Level change	yes	yes
		Techniques change among existing	yes	yes
		New techniques	no	yes
	Labour	Seasonal	yes	yes
		Permanent	no	yes
	Fin.	Indebtment	yes	yes

Data requirements

Farms

Irrigation techniques

Crops

Irrigation supply

Climate

Others parameters

Relations

Farm

- Soil by types
  - Availability
    - Property (ha)
    - Rentable (ha)
  - Water tableau (m^3)
  - Reclamation fees (€)

- Labour
  - Availability by periods
    - Family (h)
    - External (h)

- Financial capital
  - Availability
    - Own (€)
    - External (€)
- Fixed costs (€)

Irrigation techniques

- Characteristics
  - –Type (fixed-moving)
  - –Volume (l/s)
  - –Efficiency (%)
  - –Engine type (cod)
  - –Power requested (CV)

- Labour requirements
  - –Irrigation (%)
  - –Manteinance (h)

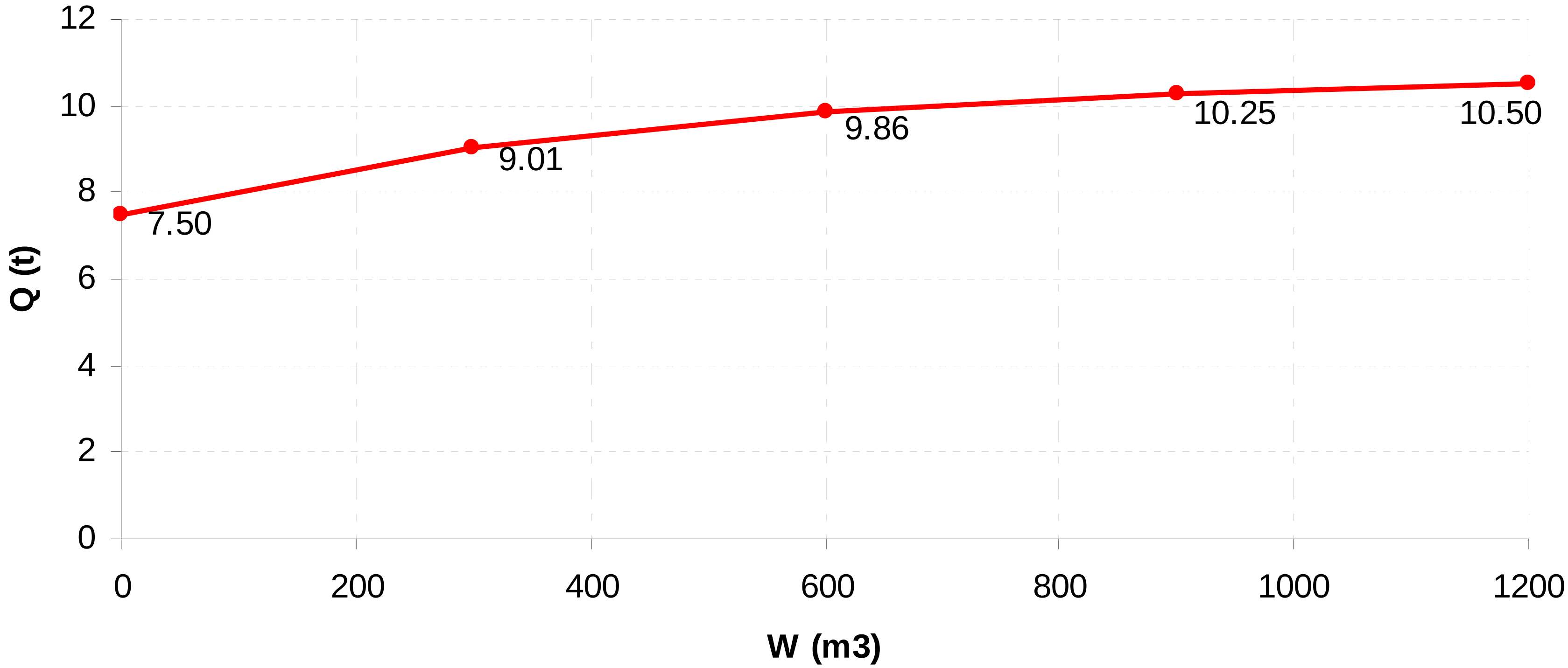
- Economic
  - –Cost (Quota) (€)
  - –External cost (€/h)

- Availability
  - –Existing (n)
  - –Maximum (n)

Crops

- Agronomic data
  - Production by water req. (t)
  - Water req. by periods (m^3)
  - Rotation requirements (n)
- Indicators
  - Energy (index)
  - Nitrate (index)
  - Soil coverage (gg)
  - …
- Labour req. by periods
  - Excluding irrigation (h)
- Economic
  - Price (€/t)
  - Subsidy (€)
  - Variable cost (€)
- Constraints
  - Political (set aside)
  - Commercial

Mais water yield function



Water supply

by levels

- Availability
  - Maximum (m^3)

- Economic
  - Price (€/m^3)

Climate

- Rain
  - by periods (mm)

- Water tableau
  - by periods (m^3)

Other parameters

- Technical
  - –Energy consumption coef.
  - –Energy price

- Remuneration
  - –Family labour (€/h)
  - –Own land (€/ha)
  - –Asset (€)
  - –Financial capital (%)

- Political
  - –COP equivalent surface (ha)
  - –Set aside requirement (%)

Relations

- Crops / Soils
- Soils / Irrigation techniques
- Crops / Irrigation techniques
- Water supply / Irrigation techniques

Irrigation requirement

$$Ir_{c,i,j,p,s} = \frac{Wr_{c,i,p,s} - Wta_{s,p} - Rain_{p}}{Eq\_ef_{j}}$$

Ir crop irrigation requirement (m^3)

Wr crop water requirement (m^3)

Wta water tableau apport (m^3)

Rain (m^3)

Eq_ef equipment irrigation efficiency (%)

Irrigation duration

$$Ir\_te_{c,i,j,p,s} = \frac{Ir_{c,i,j,p,s}}{Eq\_vol_j * 3.6}$$

Ir_te crop irrigation duration (h),

Ir crop irrigation requirement (m^3),

Eq_vol irrigation volume (l/s)

Output

- Crops mix by soil, irr.lev, irr.tecn.
- Irrigation techniques adopted
- Water consumption by supply and periods
- Employment by types and periods
- Economic indicators (Profit, NI, GM, GDP, …)
- Sustainability indicators

INDICATORS

Area	Selected indicators
Economic balance	Farm income Farm contribution to GDP Public support
Social impact	Farm employment Seasonality
Landscape and biodiversity	Genetic diversity Soil cover
Water use	Irrigation technology Water use Marginal value of water
Nutrients and pollutants	Nitrogen balance Pesticide risk Energy balance

THE MODEL IS SOLVED IN GAMS
(GENERAL ALGEBRIC MODELLING SYSTEM)

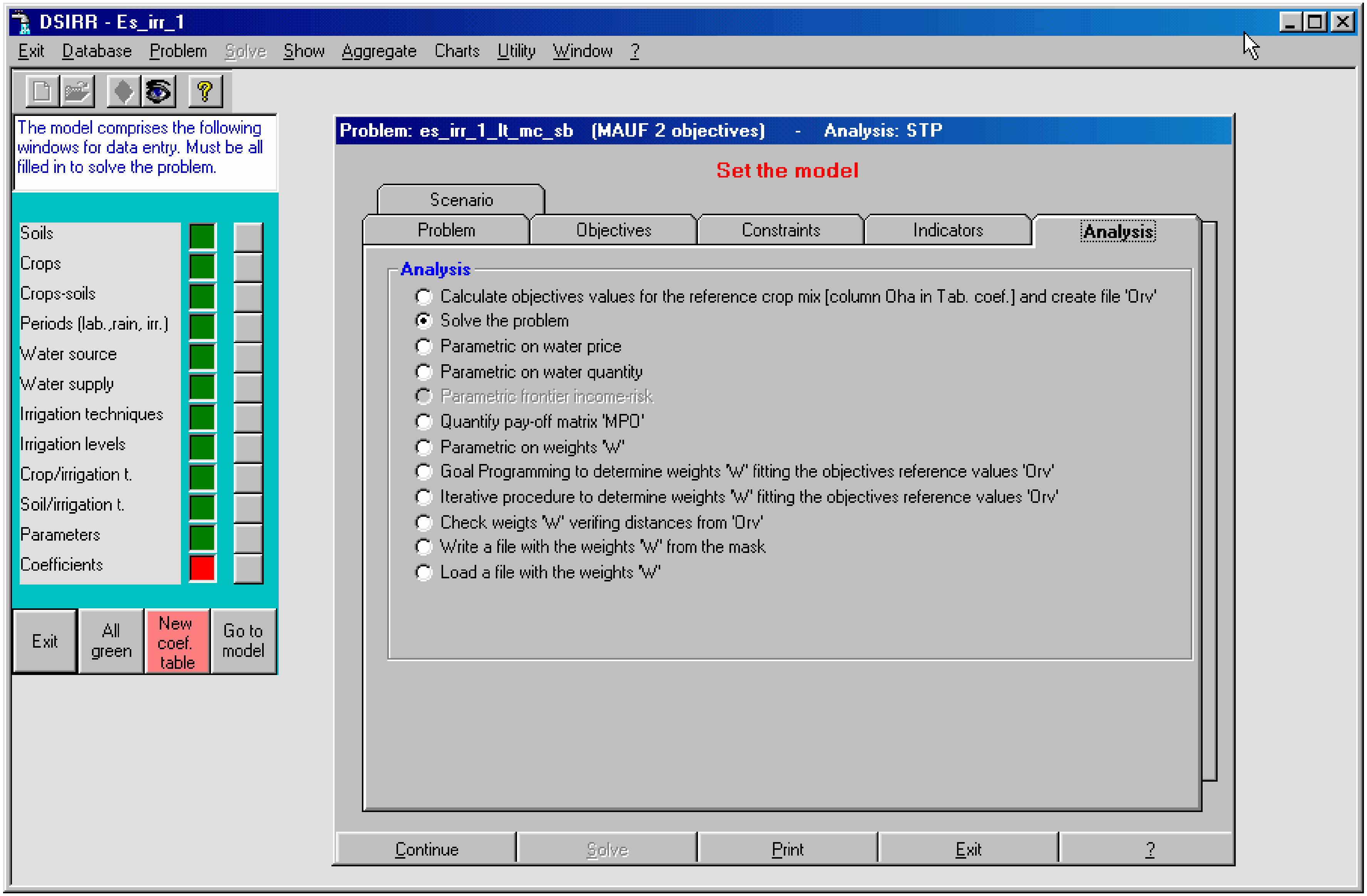
BUT THE USER DO NOT SEE IT

THE USER DEFINE THE MODEL
INTRODUCE ALL THE COEFFICIENTS
IN DSIRR

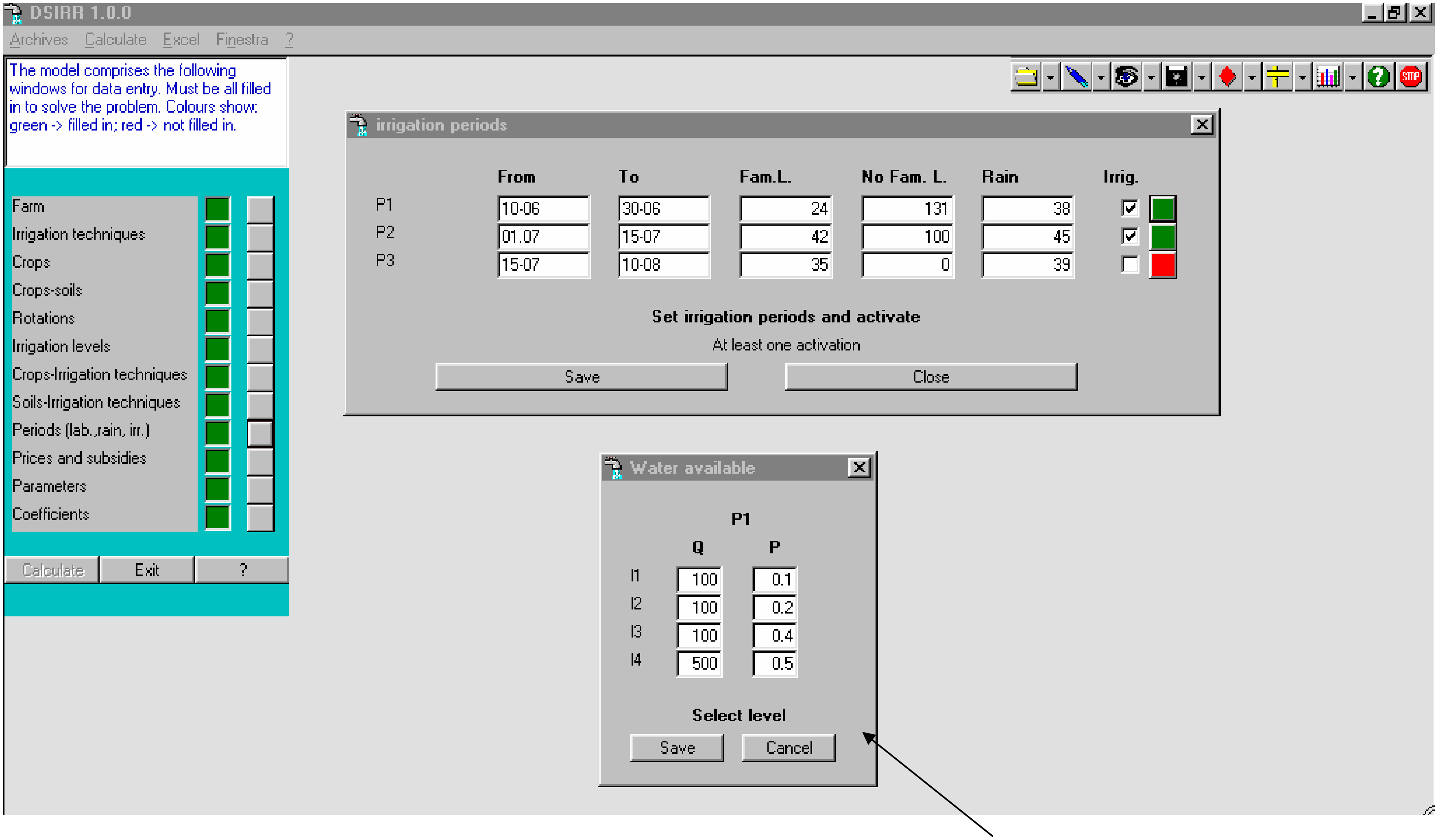
LOOK AT THE RESULTS
IN
EXCEL
TXT.FILES


DSIRR
Copyright 2001 - Rosselli Del Turco
DSIRR
Version 1.0.0
GAMS Interface for Farm Irrigation Model
Maximum dimensions: 14 crops, 3 types of soil, 1 water supply system, 3 irrigation levels, 3 irrigation periods, 5 irrigation techniques
Beta version with extended potential
Programme developed by Guido M. Bazzani and Chiara Rosselli Del Turco
ENTER
EXIT

DSIRR Graphical User Interface (GUI)

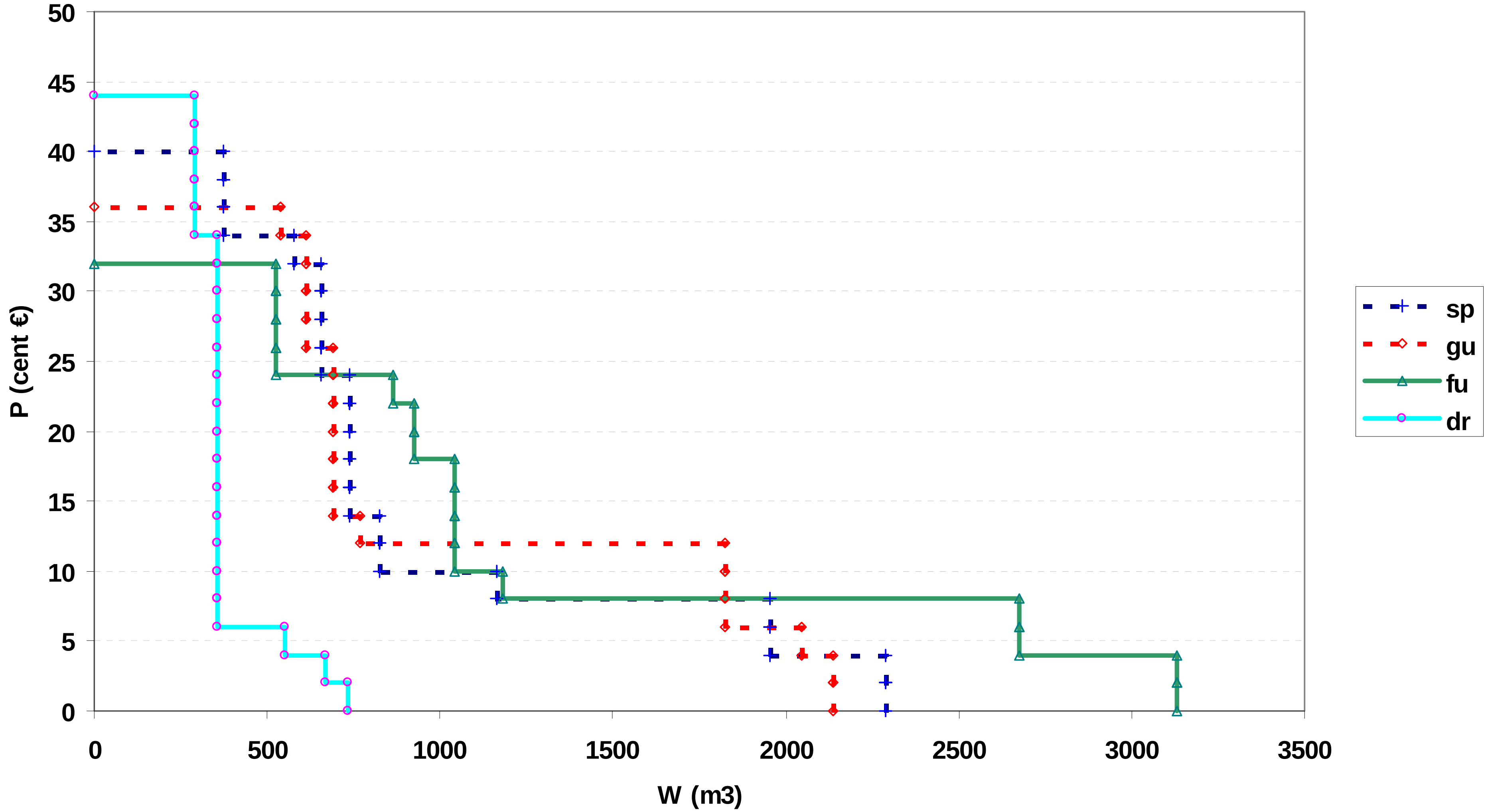


PERIODS DEFINITIONS AND WATER SUPPLY



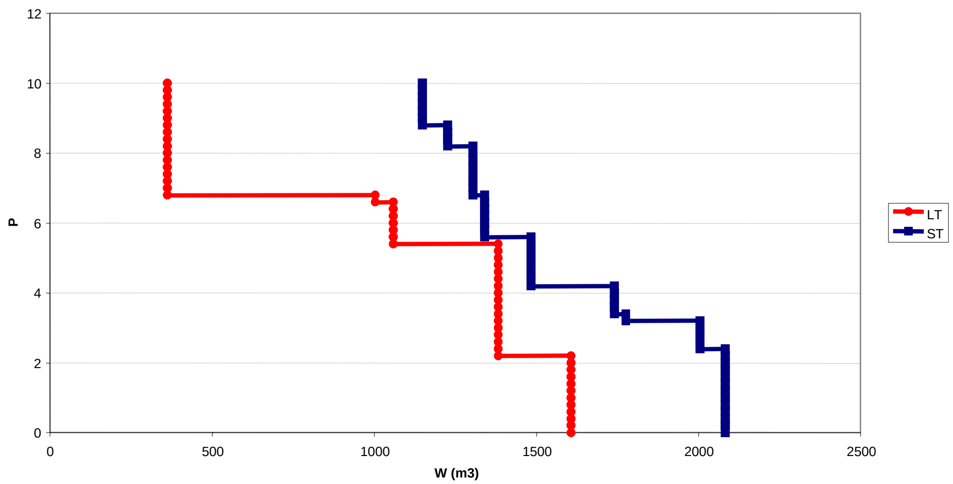
WATER OFFER CURVE – by PERIOD
(BLOCK TARIFF)

Water demand by irrigation technologies

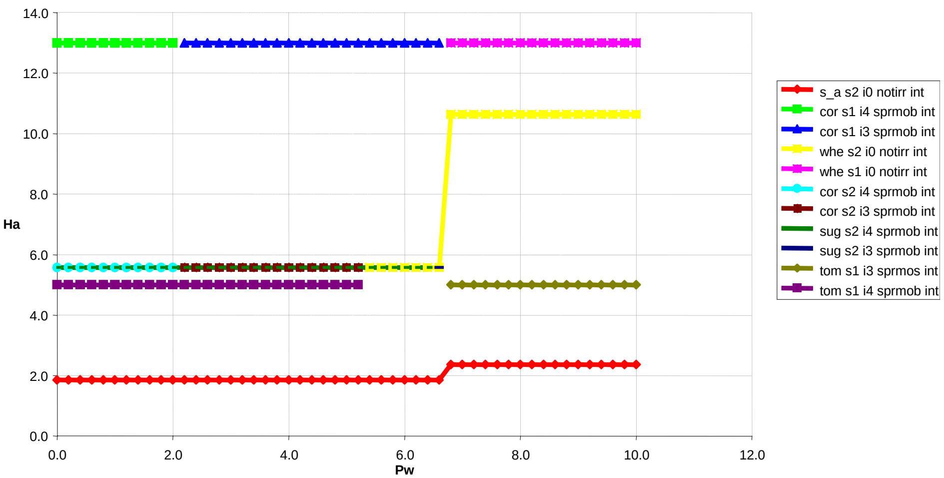


Cereal/industrial Farm in the NW Po Basin

Water demand



Crop mix in the LT



ST indices

WP	WQ	LTot	Revenue	Subsidy	C.Specif.	C.Water	G.M.
0	2083	26	2274	292	1281	0	1255
5	1484	22	2238	292	1259	74	1160
10	1149	22	2175	292	1227	115	1096

LT indices

WP	WQ	LTot	Revenue	Subsidy	C.Water	G.M.	N.Inc.
0.0	1607	20	2026	297	0	1087	602
2.0	1607	20	2026	297	32	1055	570
4.0	1382	20	1997	297	55	1025	539
6.0	1059	18	1918	297	64	977	491
8.0	363	10	1530	377	29	880	414
10.0	363	10	1530	377	36	873	407

Problem definition: indexes

• Crops	C
• Soils	S
• Periods	P
• Irrigation levels	I
• Irrigation techniques	J
• Irrigation modality	M
• Water supply modality	K
• Water supply levels	L

PARAMETERS (1)

Cmax(c)	max. surface (Ha)
Cmin(c)	min surface (Ha)
COP92	equivalent surface to 92 tonnes cereals (Ha)
Fcost	fixed cost (EURO)
Ir_su(k)	irrigable surface (ha)
Ir_fee(k)	irrigation unitary fee (EURO)
Ir_ha(j)	surface irrigable by 1 unit of equipment (Ha)
Ir_mort(j)	irrigation equipment mortage (EURO)
Ir_eff(j)	irrigation efficiency (n.p.)
Ir_cap(j)	irrigation capacity (m^3/h)
Ir_cost(f)	irrigation distribution cost (EURO)

PARAMETERS (2)

Lfa(p)	labour available (gg)
Lea(p)	family labour available (gg)
Lesal	family salary (EURO)
Lr(c,i,j,p)	requirement without irrigation (gg)
Lri(c,i,j,p)	requirement for irrigation (gg)
Rl(c)	rotation lengh in years (n)
Nro(c,i,s,j,p)	run off (kg)
Pr(c)	price (EURO)
Qu(c,f,i,s)	production (t)

PARAMETERS (3)

Rain(p)	rain
Rem	family labour
Subsidy(c)	subsidies and compensation (EURO)
Set-aside	set a side percentage (%)
Su(s)	surface (Ha)
Vc(c,i,s)	variable cost (EURO)
Wa(k,l,p)	water available ()
Wp(k,l,p)	water price (EURO)
Wr(c,i,s,j,p)	water requiremens ()
Ir(c,i,s,j,p)	irrigation requiremens ()

VARIABLES

HA(c,f,i,s,j,p)	productions (Ha)	
IR_EQ(j)	equipmemts (n)	[INTEGER]
LF(t)	family labour (gg)	
LE(t)	not family labour (gg)	
W(k,l,p)	water (m^3)	

Objective function

T =

Pr(c) * Qu(c,i,s) * HA(c,f,i,s,j,'p1') [market income]
+ Subsidy(c) * HA(c,f,i,s,j,'p1') [subsidies]
- Vc(c,i,s,j) * HA(c,f,i,s,j,'p1') [variable costs]

- Sup_ir(k,s) * Ir_fee(k) [irrigation fee]
- W(k,l,p) * Wp(k,l,p) [water cost]
- IR_EQ(j) * Ir_q(j) [irrigation equipment mortage, conserv.]
- HA(cir,f,i,s,j,p) * Wrrr(cir,i,s,j,p) * Ir_cost(f) [irrigation water distribution cost]

- LE(p) * Lsal [extra family labour]
- Rem [family labour and capital]
- Fcost [fixed cost]

Irrigation constraints

water balance

EWB(p) ..   HA(cir,f,i,s,j,p) * Wr(cir,i,s,j,p <=   W(k,l,p)

irrigation equipments (investments)

EIREQ(j,p)..   HA(cir,'f',i,s,j,p) <= IR_EQ(j,p) * Ir_ha(j)

Legislation

- The largest part of environmental legislation in Italy can be regarded as a consequence of the implementation of European Directives

- The Italian legislative and institutional framework of water policy is now broadly coherent with the rest of Europe

- There is a gap between legislation and its implementation

Law 36/1994 on water

- All water uses, including abstractions from the underground, need to be licensed

- The implementation of this measure is not easy: thousands of private abstractions need to be individuated and monitored (Pollution control and Environmental monitoring have been reorganized under the Regional Environmental Agencies)

Water quality policy

- The enforcement of a discharge regulation, based on emission standards set up at a national level [Dir. 91/271 (wastewater) and 91/676 (nitrates)]
- The financing and construction of the baseline sewage treatment network
- Regions are free to regulate discharges into watercourses according to a plan that individuates water quality objectives and use destinations
- Regional water quality plans can introduce special measures in order to protect the water environment from pollution; the approach based on “water protection zones”
  - nitrate vulnerable areas
  - sensitive areas for eutrophication

Water Use in Italy (hm^3/year)

	Civil	Industrial	Irrigation	Energy	Total	
NorthWest	2268	3520	8193	1863	15844	39.1%
NorthEast	1453	1648	5277	2538	10916	26.9%
Center	1618	1482	970	72	4142	10.2%
South	1803	879	3506	36	6224	15.3%
Islands	798	457	2191	-	3446	8.5%
Italy	7940	7986	20137	4509	40572	100.0%

NorthWest	14.3%	22.2%	51.7%	11.8%	100.0%
NorthEast	13.3%	15.1%	48.3%	23.3%	100.0%
Center	39.1%	35.8%	23.4%	1.7%	100.0%
South	29.0%	14.1%	56.3%	0.6%	100.0%
Islands	23.2%	13.3%	63.6%		100.0%
Italy	19.6%	19.7%	49.6%	11.1%	100.0%

Italian Agriculture

- Agriculture's share of total national Added Value (AV) at basic prices for the primary sector, including forestry and fishing, was about 2.8% in 2000.

- Large regional differences

	AV	Employment (measured in standard work units)
Centre-North	**2.6%**	**4.8%**
South	**5.3%**	**12.2%**

(AV new ESA 2000, Empl. 1998 ISTAT figures).

Irrigable/Irrigated Used Agricultural Area (ha)

	Irrigable		Irrigated	
	area	area/UAA (%)	area	area/UAA (%)
Piemonte	482 302	42.1	396 838	34.6
Valle d'Aosta	26 847	31.0	18 893	21.8
Lombardy	785 563	70.1	671 209	59.9
Trentino-Alto Adige	70 625	16.5	64 111	15.0
Veneto	476 966	54.0	298 832	33.8
Friuli-Venezia Giulia	114 069	42.2	59 229	21.9
Liguria	13 070	15.4	19 846	23.3
Emilia-Romagna	621 275	50.7	279 870	22.8
Tuscany	131 196	14.1	70 677	7.6
Umbria	58 035	15.7	45 105	12.2
Marche	59 910	10.0	37 852	6.3
Lazio	164 654	20.2	111 475	13.6
Abruzzo	74 667	14.4	49 251	9.5
Molise	30 297	12.4	8 562	3.5
Campania	150 306	23.0	121 517	18.6
Puglia	383 408	26.5	256 299	17.7
Basilicata	75 544	12.2	42 371	6.8
Calabria	136 800	21.6	101 387	16.0
Sicily	263 418	16.9	209 272	13.4
Sardinia	193 998	14.6	81 905	6.2
ITALY	**4 312 952**	**28.8**	**2 944 500**	**19.7**

Source: ISTAT Survey on the Structure and Production of Farms (1998, 1996).

Main crops production and irrigation

	Volume ('000 tonnes)	% change 2000/99	Value (million €) **	% change 2000/99	
Soft wheat	3 152	-2.4	715	-1.3	4.6%
Durum wheat	4 313	-4.5	1 086	0	7.1%
Maize	10 412	3.9	1 856	0.4	12.1%
Rice	1 230	-13.8	419	-7.6	2.7%
Sugar beet	11 561	-18.1	527	-6.7	3.4%
Tobacco	130	3.2	341	7.7	2.2%
Soya	923	6.1	316	2.8	2.1%
Sunflowers	456	5.2	184	-2.6	1.2%
Potatoes	2 155	4.1	444	-6.5	2.9%
Tomatoes	7 730	4.1	1 104	1.3	7.2%
Dessert grapes	1 256	2.2	458	14.3	3.0%
Sold grapes	4 227	-4.1	1 023	-7.4	6.6%
Wine ('000 hl) (1)	23 638	-7.2	1 924	-11	12.5%
Sold olives	276	-28.6	135	-29.9	0.9%
Oil (1)	459	-29.8	1 827	-21.1	11.9%
Apples	2 241	-4.4	643	-11.7	4.2%
Pears	941	16.1	376	14.1	2.4%
Peaches and nectarines	1 655	-6.3	685	2.2	4.4%
Oranges	2 276	31.3	586	14.7	3.8%
Lemons	708	30.1	283	16.8	1.8%
Mandarins and clementines	672	13	223	-0.1	1.4%
Kiwi	353	5.7	240	-5.5	1.6%
Total			15 389		100%

At basic prices.

(1) Only wine and oil made from the farm's own grapes and olives are considered

EU WADI PROJECT

objective is to evaluate the

Economic

Social **Sustainability**

Environmental

of European irrigated agriculture

under **Water Framework Directive** (**WFD**)
and different scenarios concerning
the **Common Agricultural Policy** (**CAP**)

EU WADI PROJECT

Spain
Portugal
Italy
Greece
England

Environmental policy instruments

	Water resources use and quality
Planning	Water resources plans Basin plans should program water balances for relevant sections of watercourses according to use destinations and and related water quality requirements
Licenses	All water uses *(groundwater since 1994) and discharges into watercourses and into public sewers need to be licensed* Discretional definition of “public interest” for the release of licenses *Priority ladder with respect of minimum flows and environmental needs*
Regulation / prevention	Weak monitoring and control of actual abstractions. Code of good agricultural practice obligatory in vulnerable areas
Zoning	Water resources plans can vinculate particular resources to drinking supply schemes and define appropriate protection measures
Pricing Environmental taxation	Abstraction fees (very modest) *Charges for water services set on a cost recovery base (not full-cost)*
Environmental subsidies	Water transfer infrastructure almost totally financed by the state· Public budget covers a relevant part of the operational budget of water supply organizations, especially in the case of irrigation
Water markets	Not used
Management agreements	Codes of good practice voluntary outside vulnerable areas Voluntary programs for reducing pesticides and fertilizers

Considerations

It must be stressed that
water is a fundamental input for Italian agriculture:

it can be estimated that
- 40% of the added value in agriculture
- 60% of agricultural export

depends on irrigation (Anbi 1992)

Given that a large part of the agricultural system
especially the "productive" part
has been organized according to the
expected availability of water
short term losses due to water shortage
can be severe

The Reclamation Boards

he reclamation boards (RB) are public bodies

he participation is compulsory

for owners of real estates in the RB area

hey are administered by associates

ims:

design and implement land reclamation and irrigation

infrastructures

Tariff system

There is a variety of payment schemes often building on ancient rules about water use

Tariff system is mainly based on the distribution of RB costs among beneficiaries

Investment costs (funded by state/UE) are not taken into account

Full cost recovery is not achieved
No environmental cost is considered

Tariffs are usually established on per unit of surface
A few RB have tariffs per unit of water consumption

Pricing

- Volumetric water pricing cannot be applied in a large part of Italy
    - the existing network (open channels) do not allow metering only flat rate can be used

- Where volumetric pricing is enforceable due to modern on pressure network water demand is quite rigid

  (fruit and vegetable)

  high irrigation efficiency is achieved (>90%)

  – Volumetric water pricing affects the net farm income but does not reduce the water demand
  – A full-cost pricing of collectively supplied water could favour the use of private wells

Considerations

- **Irrigated agriculture in Italy determines many positive function (externalities) among which:**
  aquifer recharging and landscape creation

- **A mix of policy instruments both in agriculture and water pointing to an integrated water management focusing on the reduction of negative impacts seems the best solution to meet the overall sustainability of the system**
  - **technical advice**
  - **research and innovation in irrigation and agriculture**
  - **renovation and maintenance of the existing infrastructure**

Integrated management

The Water Management System WMS is increasingly characterized by

- ***territorial integration*** *(Basin approach)*
  - *for water supply and sewerage "optimal management areas"*
  - *a gradual increase of water prices allowed to reach operational cost coverage, with some extra margin for depreciation*

- ***water users*** *(agriculture-industrial-civil)*
  - *multiple use of infrastructures*
  - *reusing wastewater for irrigation*

- ***water resources*** *(surface and underground)*
  - *interconnection of water networks at the provincial level eases a policy in which both surface and underground waters are used in a sustainable way*

Future orientation

Multiperiod models
Water markets
…

Main features

- direct control of the simulation by the user (GUI)
- a rich set of models to apply multicriterial MPT
- quantifiable results covering socio, economic and environmental aspects related to irrigated agriculture
- great flexibility
- reduction of time and cost to conduct sound studies

DSIRR a tool to support water initiatives and take sustainable decisions in a participatory process with stakeholders

Any possible integration ?

Thank you for your attention

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