Joint assessment of water and agricultural policies: a Pan-European multidimensional modelling approach

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Outline

- Sustainability and the food-water-environment nexus
- Food-water linkages in global agro-economic models
- The CAPRI water module
- Potential to jointly assess food and water policies
- Pilot case study
- Further development

Sustainability and the food-water-environment nexus

Strong linkages between water, food and the environment

Irrigation water use has been identified as one of the major sustainable water management issues in the implementation of the Water Framework Directive

The WFD foreseen to be included into cross-compliance in the CAP post-2013

Food-water linkages in global agro-economic models

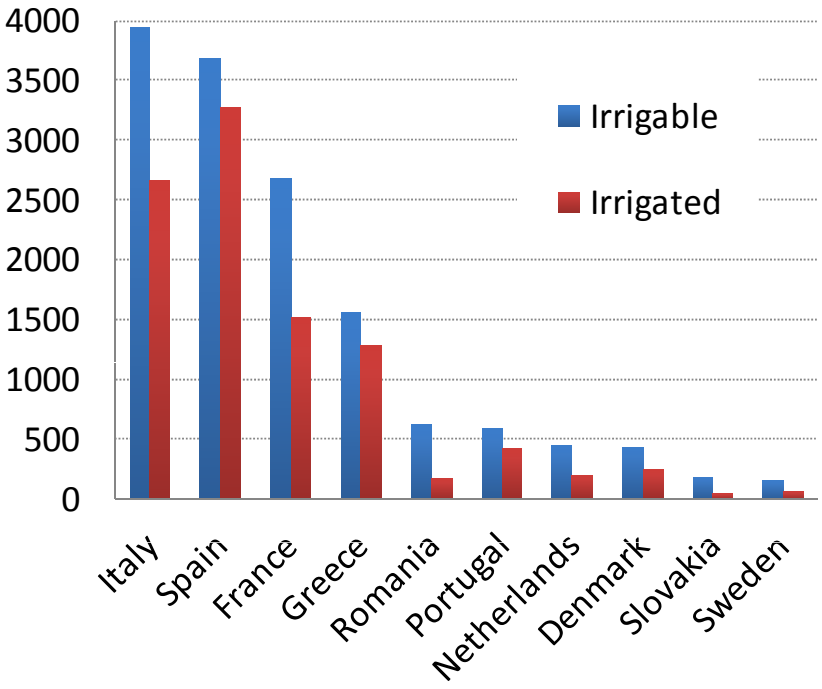
Extensive work in food-water linkages but most studies are site specific

Very few agro-economic models deal with water issues at the EU or global level

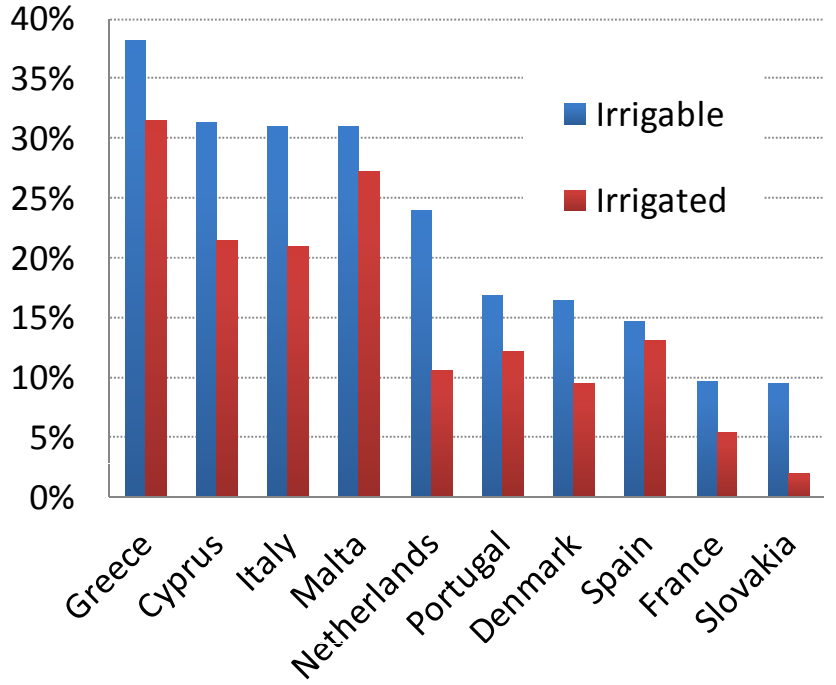
- IMPACT-Water (developed at IFPRI)
- WATERSIM (common initiative IFPRI-IWMI)
- GLOBIOM (developed at IIASA)

More than 10 Mha irrigated in the EU and increasing trend

Major irrigators in absolute terms (1000 ha)



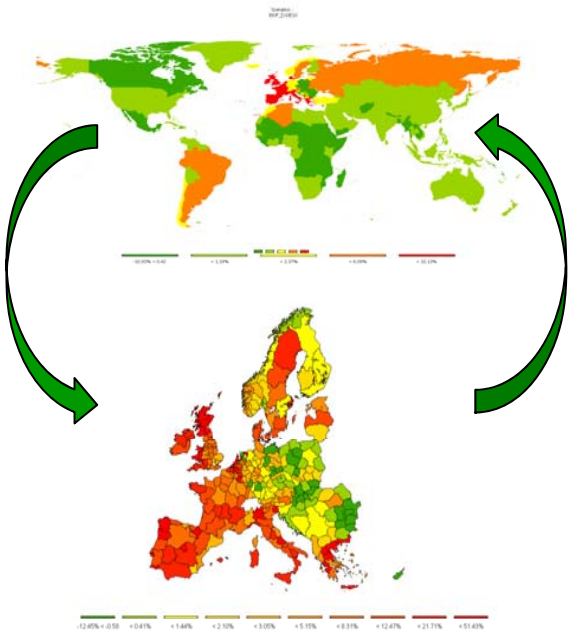
Major irrigators in relative terms (%UAAR)



Source: Data from EUROSTAT

What is CAPRI?

- Spatial partial equilibrium model of agricultural commodity markets at the global level
- Two interlinked modules:



Global Spatial Multi-Commodity Model

77 countries in 40 trade blocks, 60 primary and secondary products, agricultural and trade policy measures

Regional Programming Models

280 regions for EU27+Norway +Western Balkans, detailed representation of farming decisions and CAP measures

Why a water module for CAPRI?

High capability to integrate water considerations

- Compared to other partial equilibrium models, the programming approach of the CAPRI supply module shows high flexibility to integrate agriculture-water relationships
- Compared to other programming approaches, CAPRI includes market feedback and covers the whole EU

How to expand CAPRI with a water module?

Modular implementation

- Stand-alone module important for test phase

Step-by-step integration of water issues

- Irrigation sub-module: irrigated activities (EU regions)
  - => Tested in pilot regions, reported here.
- Water use sub-module: water balance approach (EU and non-EU regions)
  - => Concept developed, databases checked, but implementation pending due to data problems

Irrigation sub-module

Supply side

- Water availability and competition with other sector
- Marginal water costs

Demand side

- Irrigation water requirements
- Crop-yield response to water

Policy considerations

- Water Framework Directive
- CAP measures

Irrigation water database (1)

The irrigation sub-module requires a great deal of information:

- Irrigation water requirements
- Actual irrigation water use
- Irrigated and rainfed areas and associated yields
- Irrigation costs

Data sources

- EUROSTAT provides total irrigable and irrigated areas at the NUTS 2 level. However, crop-specific irrigated areas are only available for a selected group of crops (and only for some regions)

Irrigation water database

As irrigation water use is lacking in official statistics, potential irrigation requirements has been used instead

- Net irrigation requirement approximated through crop-specific water balances
- Gross irrigation requirement determined by the NIR and the irrigation technology
- Yield response to water derived from biophysical models

Joint estimation framework to fill data gaps and keep consistency

Pilot case study

Pilot case study to test the feasibility of the approach

Two NUTS2 regions:

- Andalucia (high share of irrigation)
- Midi-Pyrenees (increasing need for irrigation in the future)

Irrigation data from EUROSTAT and national statistics

Including the main irrigated crops in these regions

Simulating irrigation water taxes in 2020

Scenario setting

Baseline scenario

- Continuation of current policies and the most probable technology development until 2020
- Based on existing medium term outlooks for agricultural markets
- Irrigation trends based on national studies

Counterfactual water pricing scenario

- Differs from the baseline only in the irrigation water price, ranging between 0.2 to 0.4 Euros per cubic meter, for example due to a new tax

Rainfed and irrigated areas in the Andalusian region (1000 ha) in the reference run

	Baseline	Baseline (with irrigation module)		
		Average	Rainfed	Irrigated
Utilized agricultural area	5469.3	5469.3	4468.9	1000.4
Cereals	680.3	680.3	592.4	87.9
Oilseeds	172.0	172.0	152.2	19.8
Other arable crops	190.3	190.3	190.3	0.0
Vegetables and Permanent crops	1972.5	1972.5	1079.9	892.7
Soft wheat	96.6	96.6	88.8	7.7
Durum wheat	318.7	318.7	293.2	25.5
Barley	113.6	113.6	113.6	
Grain Maize	27.8	27.8		27.8
Paddy rice	26.9	26.9		26.9
Rape	1.3	1.3	1.3	
Sunflower	165.0	165.0	145.2	19.8
Soya	0.9	0.9	0.9	
Potatoes	8.3	8.3		8.3
Sugar Beet	13.1	13.1	13.1	
Tobacco	0.5	0.5	0.5	
Tomatoes	8.7	8.7		8.7
Other Vegetables	21.8	21.8		21.8
Apples Pears and Peaches	25.7	25.7	10.3	15.4
Other Fruits	199.5	199.5		199.5
Citrus Fruits	84.6	84.6		84.6
Table Grapes	1.4	1.4	1.4	
Olives for oil	1476.6	1476.6	959.8	516.8
Table Olives	107.3	107.3	69.7	37.5
Wine	27.1	27.1	27.1	

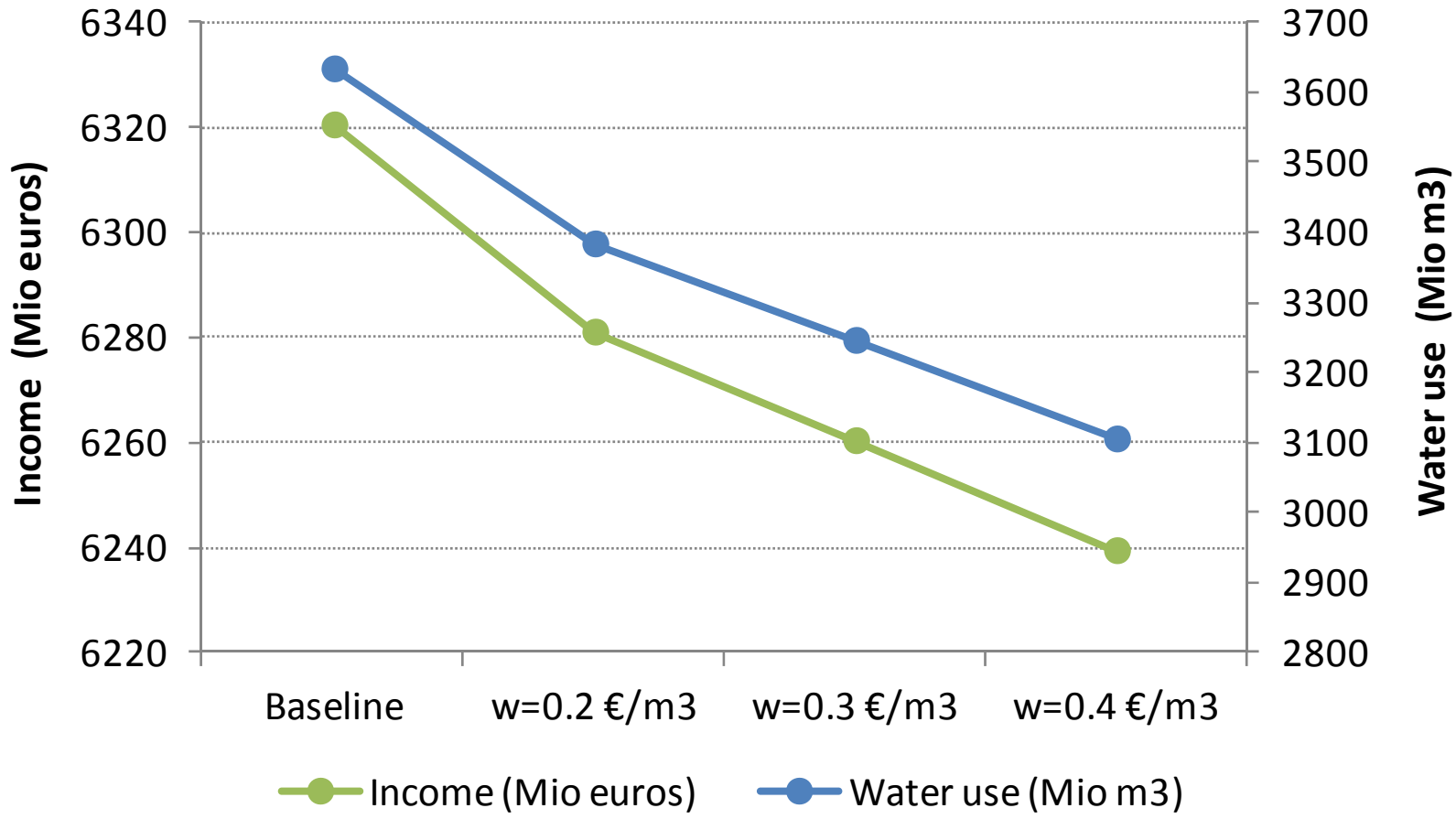
Impacts of water prices on irrigated areas and water use (Andalucia)

	Baseline scenario	Irrigation water price scenario		
		0.2 €/m3	0.3 €/m3	0.4 €/m3
Irrigated area (1000 ha)				
Cereals	87.87	71.69	63.13	54.55
Oilseeds	19.81	14.74	11.9	9.15
Fruits and vegetables	338.33	328.34	321.91	315.05
Olive groves	554.34	551.89	548.81	545.22
Total irrigated land	1000.35	966.66	945.75	923.97
Utilized agricultural area (1000 ha)	5469.25	5469.25	5461.8	5452.23
Irrigation share (%)	18.29	17.67	17.32	16.95
Water use (Mio m3)	3633.93	3383.99	3246.2	3105.48

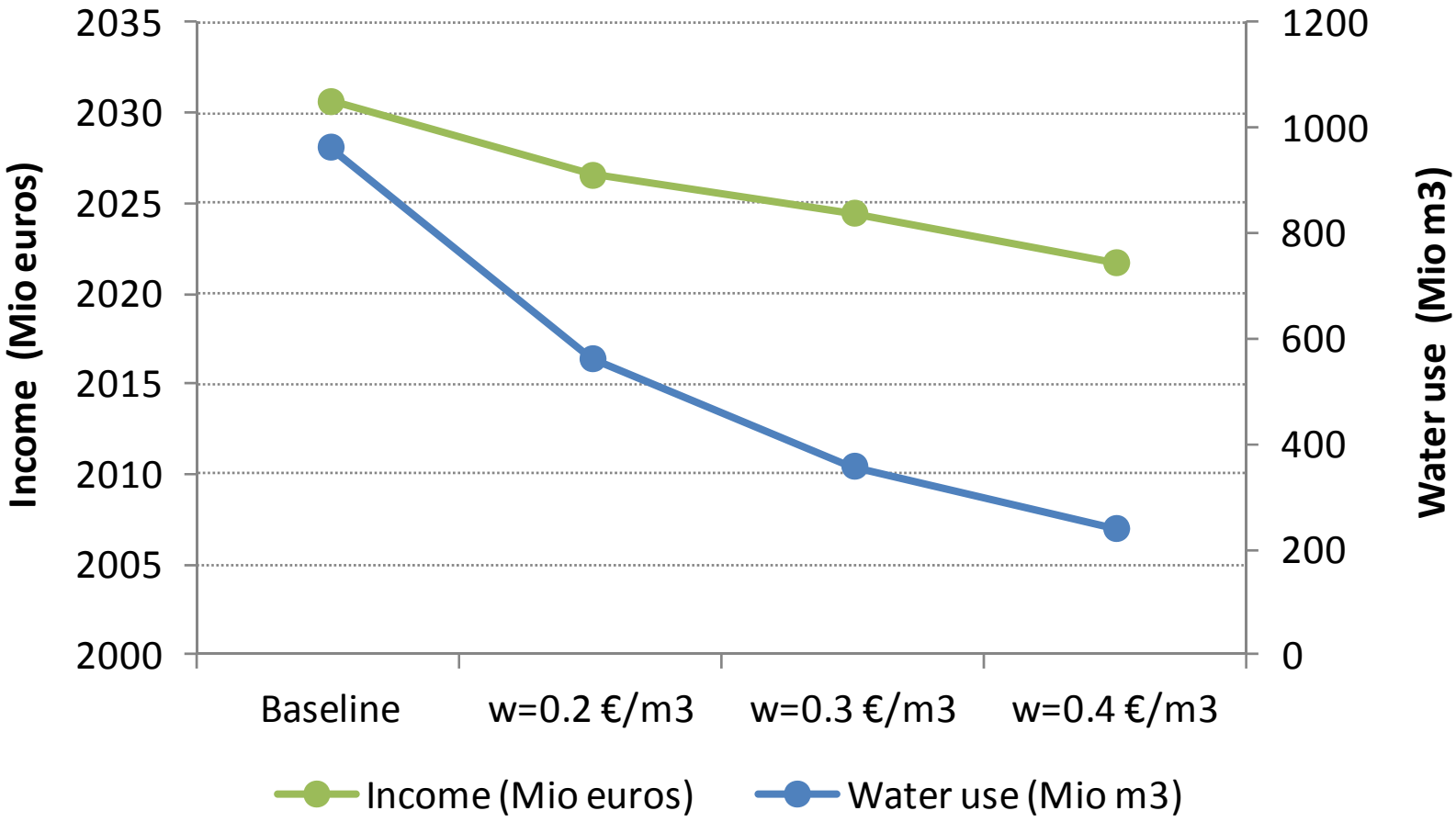
Impacts of water prices on irrigated areas and water use (Midy-Pyrenees)

	Baseline scenario	Irrigation water price scenario		
		0.2 €/m3	0.3 €/m3	0.4 €/m3
Irrigated area (1000 ha)				
Cereals	128.14	72.66	44.46	25.84
Oilseeds	42.03	36.31	33.34	30.21
Fruits and vegetables	9.24	9.22	9.21	9.2
Olive groves				
Total irrigated land	179.41	118.19	87.01	65.25
Utilized agricultural area (1000 ha)	2469.73	2469.73	2469.73	2469.73
Irrigation share (%)	7.26	4.79	3.52	2.64
Water use (Mio m3)	963.93	562.57	358.65	240.48

Agricultural income and irrigation water use under alternative water pricing scenarios (Andalucia)



Agricultural income and irrigation water use under alternative water pricing scenarios (Midi-Pyrenees)



Market feedback

Because of decreasing supply for irrigated crops, producer prices increase as the water price increases

- In this case study, the effect on producer prices is only significant in the case of rice
- The effect is minor in all other crops because shocks only affect one NUTS 2 region

Achievements

The water module sheds light on an environmental indicator for far neglected in CAPRI

May also give more realistic supply functions

The approach enables to analyse agrifood and water policies in a joint framework

In contrast with most commonly used approaches, feedback mechanism through market prices are taken into account

To do list

As a first step, we will extend the application of the irrigation module to cover all NUTS 2 regions

As a second step, it is foreseen to further develop the CAPRI water module to account for competition between agricultural and non-agricultural water use in a more detailed way

- Building a water use sub-module to account for water use balances at the regional level
- Incorporating water also for non-EU regions (in the market module of CAPRI)