Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria

Centro di ricerca
Politiche e Bioeconomia

The economic impact of climate change on irrigated Italian farms

29° Pacioli Workshop – Montegrotto, Italy
6th-9th October 2024

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Outline

- Water irrigation issues in Europe and Italy
- The Irrigated agriculture diffusion in Italy
- Analysis of irrigation adoption in Southern Italy FADN Farms
- Estimated impacts on farm performance by irrigated water scarcity
- Discussion and perspectives

AIM of the study

Analyse the reduction of performance due to climate change on irrigated farms in southern Italy

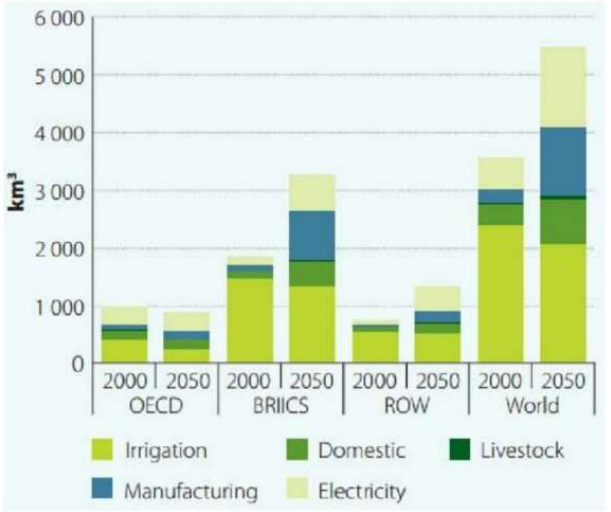
- Overall
- By irrigation share
- By FT and regions

Global and European Framework

- Global water demand for all uses, presently about 4,600 km^3 per year, will increase by 20% to 30% by 2050 (FAO, 2018).

	World water use
Agriculture	70%
Industry	22%
Domestic use	8%

Global water demands in 2000 and 2050



Ph. Dalezios et al.2018

- Global water demand for agriculture will increase by 60% by 2025.
- The increase in water demand and the **degradation of freshwater** due to **urbanisation**, **agricultural intensification**, and climate changes, have become major-concerns, especially in regions that are already under water stress conditions, with significant consequences for irrigation requirements, **especially in semi-arid area of Southern Europe and Mediterranean, which are recognised as a** CLIMATE CHANGE HOTSPOT.

Water for irrigation in agriculture - Italy

- Significant variability in local water availability and annual rainfall over the last 16 years decreased by 5%.
- A **generalized increase in both minimum and maximum temperatures** and significant rainfall reduction is expected (+0,6°C in the period 1981-2010; +1°C in the period 1971-2020)
- A **significant precipitation reduction** is expected in summer and spring in Southern Italy with values ranging between 5% and 10% depending on the emission scenario (-34,3 mm in the period 1981-2010; -55,8 mm in the period 1971-2000)
- The foreseen changes in climate (prolonged periods of drought, extreme events and changes in the rainfall regime) present **risks for the quality and availability of water resources.**

- As a result of **prolonged dry periods** (increasing in Italy according to the analysis carried out on climate change scenarios) negative effects on water quality, flow rate reductions and inflow velocities are expected.

Policy dedicated to water protection

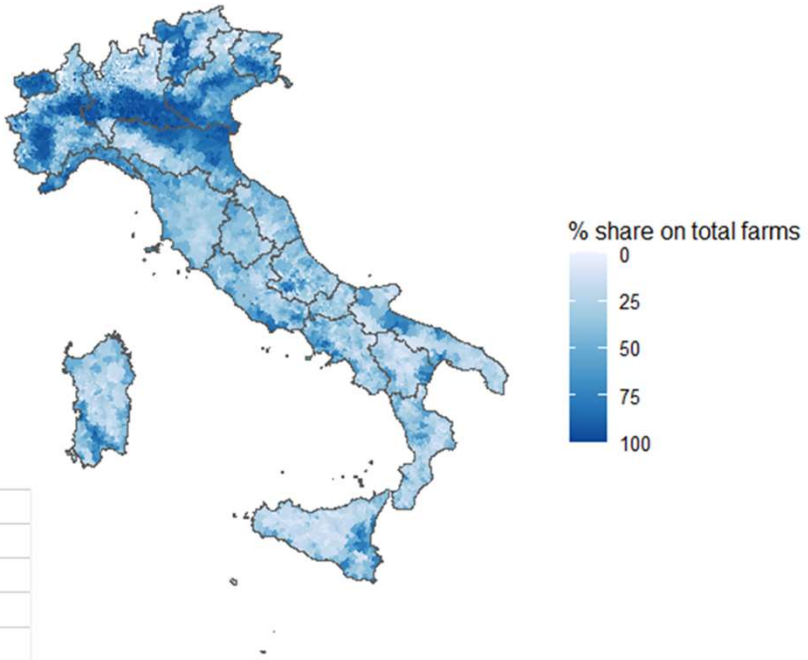
- In the last decades, in order to limit the climate change effects on agriculture and natural resources as water, **European commission** applied strategies and policies (as the **Common Agriculture Policy – CAP**) that could contribute to efficient management **of water by supporting sustainable water use in line with the objectives of the Water Framework Directive (2000/60/EC)** that provides a framework for water protection and management in the EU.

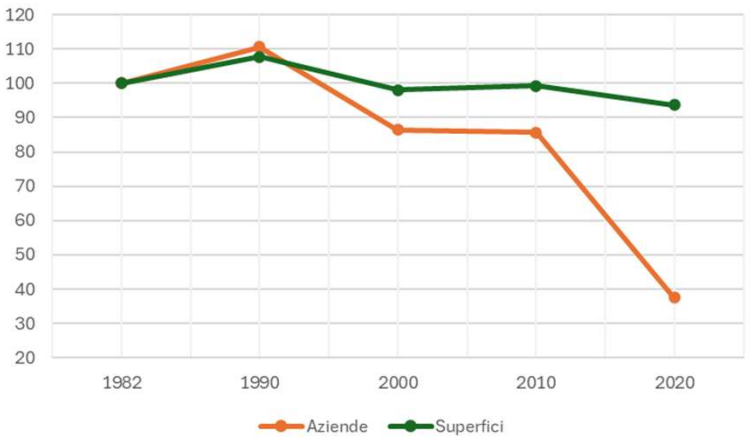
- Indeed, a **sustainable management** is particularly relevant to water resources for agriculture as the world's supply of clean and fresh water is steadily decreasing and extreme events (drought, floods) are becoming more frequent.

- Sustainable management of water (quantitative and qualitative), also one of the **Sustainable Development Goals of Agenda 2030,** is encouraged by the CAP (Picone et al., 2021) because it allows quality food production and food safety.

Irrigated agriculture in Italy (Agricultural Census, 2020)

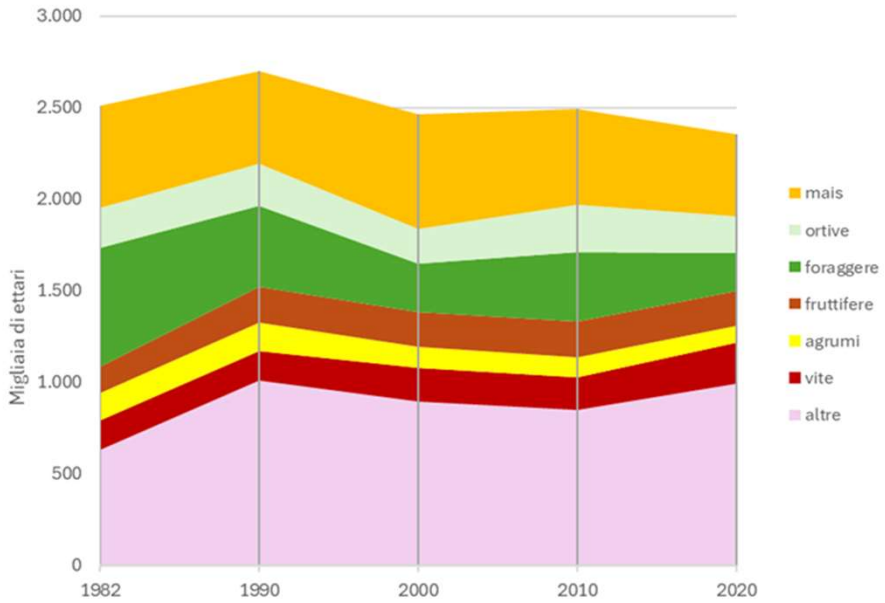
- 43% of all farms; 30% of total UAA
  46% of production value derives from irrigated crops
- Irrigated farms are decreasing, irrigated UAA is stable
- From 3 ha to 7,6 ha irrigated UAA per farm in 2020
- In the North, historically vast irrigation networks have developed





Irrigated crops in Italy (Agricultural Census)

Hectares of irrigated crop group (,000 of ha)



Variation of Irrigated UAA per crop group (% 2020/2010)

	North	Centre	South	Italy
Corn	-7,8	-81,0	**-66,7**	-20,0
Horticulture	30,7	-19,9	**-18,7**	-7,1
Leguminous crops	-68,9	-84,5	-47,5	-68,1
Vineyard	129,7	-5,1	3,4	40,6
Citrus trees	429,3	4,5	**-36,5**	-36,0
Fruits	18,1	203,5	16,1	28,4
Other	70,8	-12,0	40,6	57,0
Total	**1,1**	**-46,0**	**-9,0**	**-6,3**

- Irrigation decrease is highest in the Centre.
- Vineyards and fruits have increased the most.
- Citrus decrease also significantly.

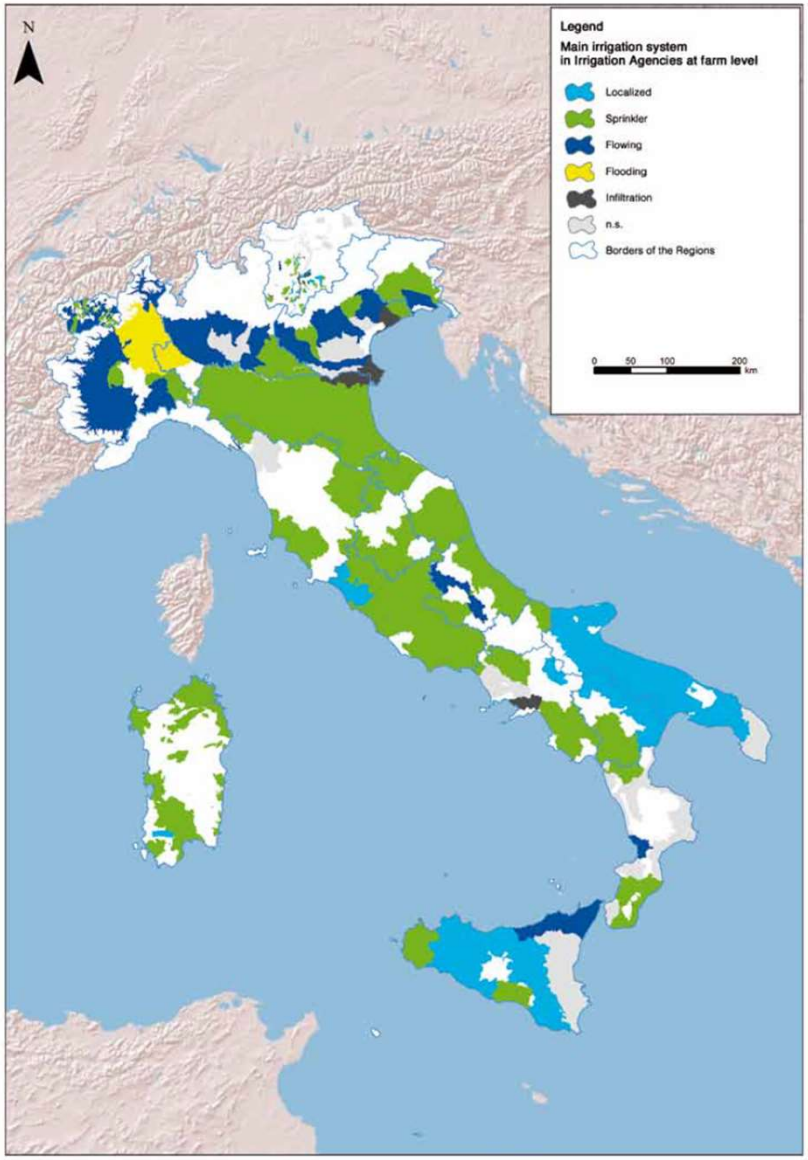
Main irrigation systems in irrigation agencies at farm level

In Southern regions: 72% of water supply stems from groundwater and 12% from rivers

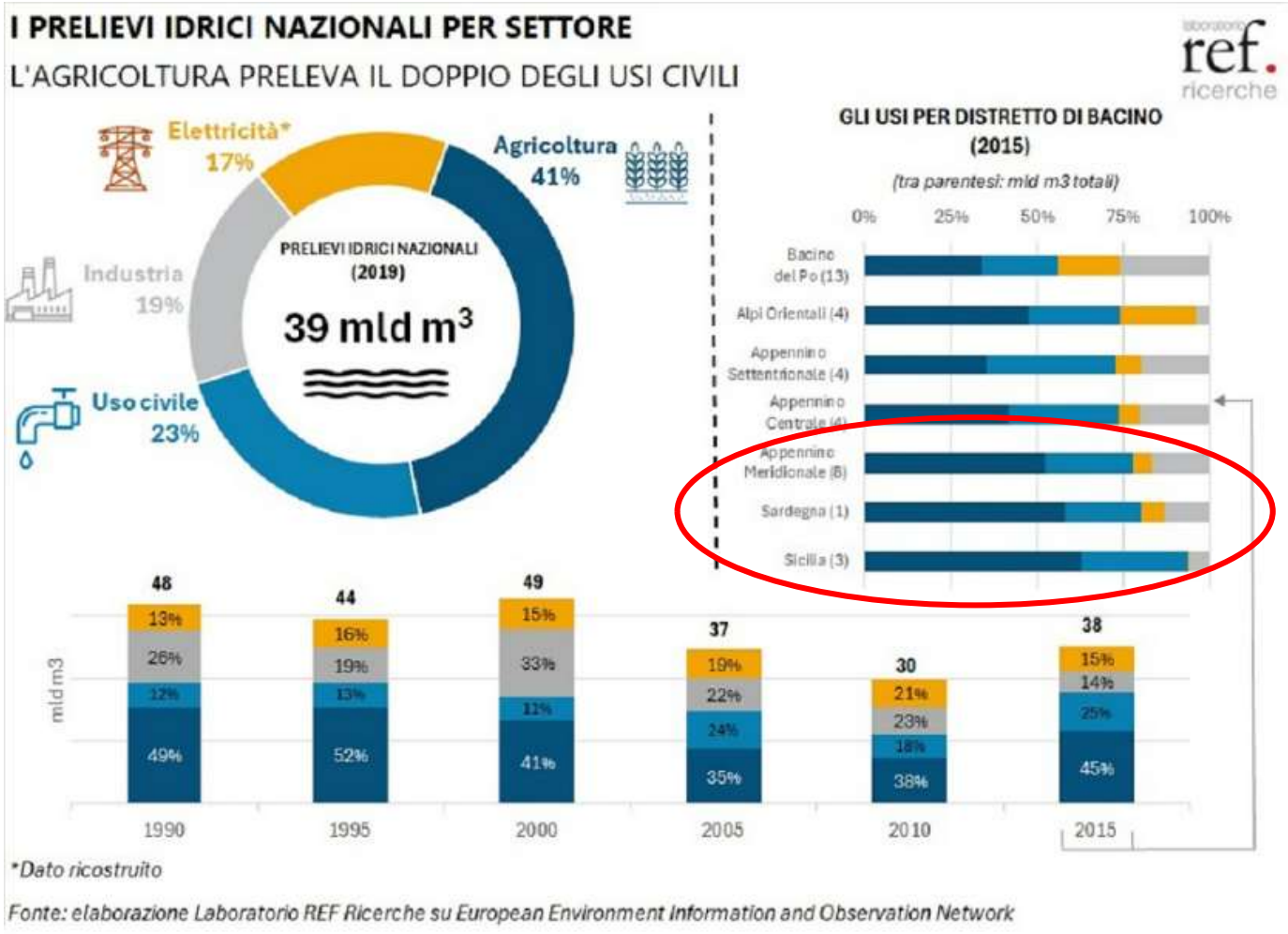
1,3 millions ha of equipped land:

- 13% in Southern Apennine
- 43% Po river

- In South and Islands reclamed areas are restricted to **floodplains along the coast**



The main use of water is for agriculture, especially in the South and Islands



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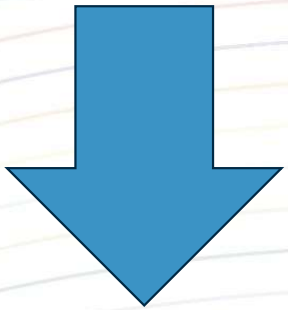
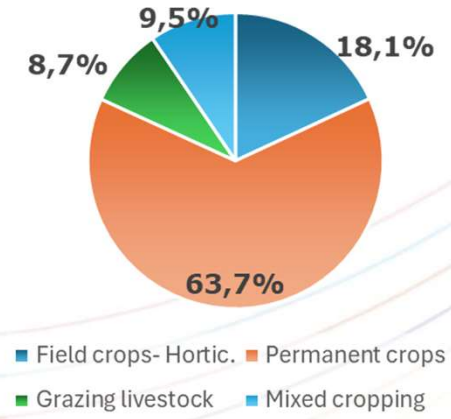
FADN irrigated farms characteristics

in Southern Italy



Farms' Analysis of irrigation adoption (FADN)

- Mediterranean regions (Campania, Calabria, Basilicata, Puglia, Sicilia, Sardegna) because of water scarcity in the area and imbalance between water availability and irrigation needs
- FADN, 2020-2022
- Only specialised farms and with crops
- Mountain farms excluded because of climate area



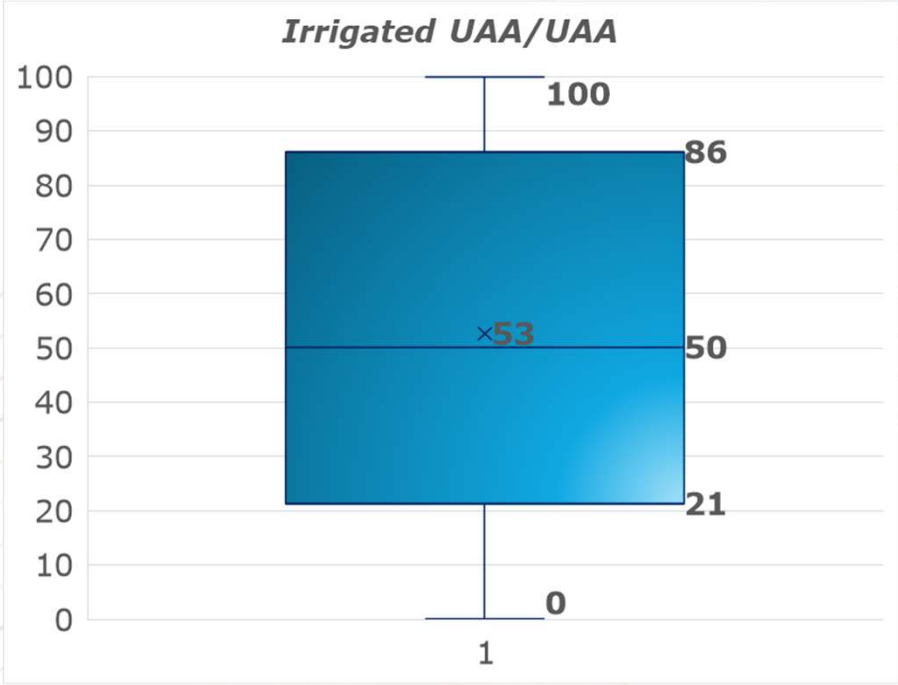
Source: FADN, 2020-2022

	Number of farms	***UAA (ha)***	***Irrigated UAA (ha)***	***Irrigated UAA /UAA (%)***
Field crops	913	38,0	4,0	10,5
Permanent crops	3.210	18,7	5,4	28,6
Grazing livestock	436	60,2	3,3	5,5
Mixed cropping	480	24,7	2,9	11,6
All irrigated farms	**5.039**	**26,4**	**4,7**	**17,8**

Irrigation share levels

- Identification and grouping of farms according to irrigation share distribution

	Irrigated UAA/ UAA (%)	Observations (%)
Level 0	0	
Level 1	1-20	24
Level 2	21-50	26
Level 3	51-85	24
Level 4	86-100	26



Farm characteristics of FADN irrigated farms

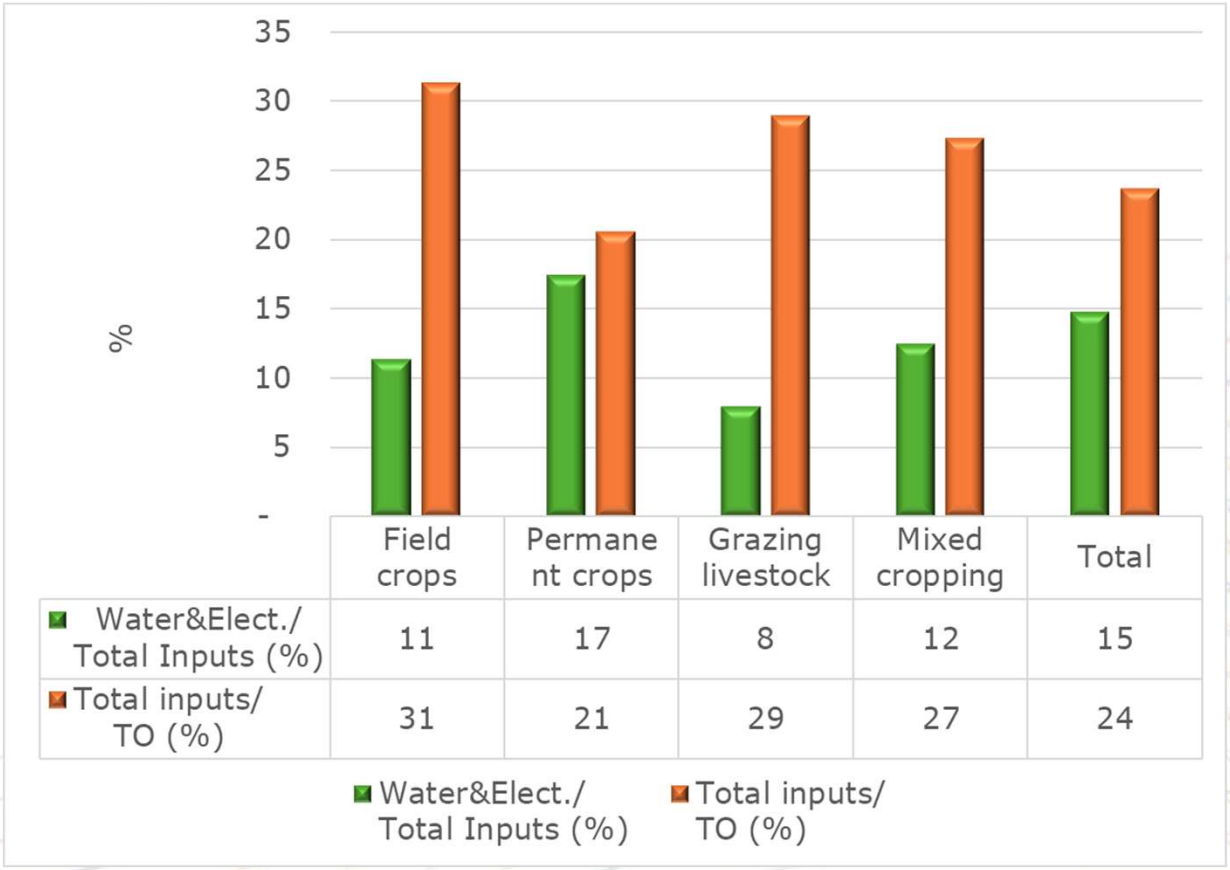
FT with the highest share of irrigation are specialised with permanent crops and field crops

Irrigation share (%)	*Field crops+ Hort.*	*Perm. crops*	*Grazing livestock*	*Mixed cropping*	*Total*
1-20	32%	17%	42%	49%	24%
21-50	29%	26%	29%	17%	26%
51-85	15%	28%	15%	14%	24%
86-100	23%	29%	14%	20%	26%
Sub-total	**17%**	**69%**	11%	3%	100%
No irrigation	19%	60%	9%	13%	100%
Total	32%	17%	42%	49%	24%

	No. Obs.	**Average UAA (ha)**	**Average IAA (ha)**
1-20%	513	36,8	3,2
21-50%	573	24,9	8,5
51-85%	528	22,9	15,4
86-100%	565	16,3	15,9

Source: FADN, 2020-2022

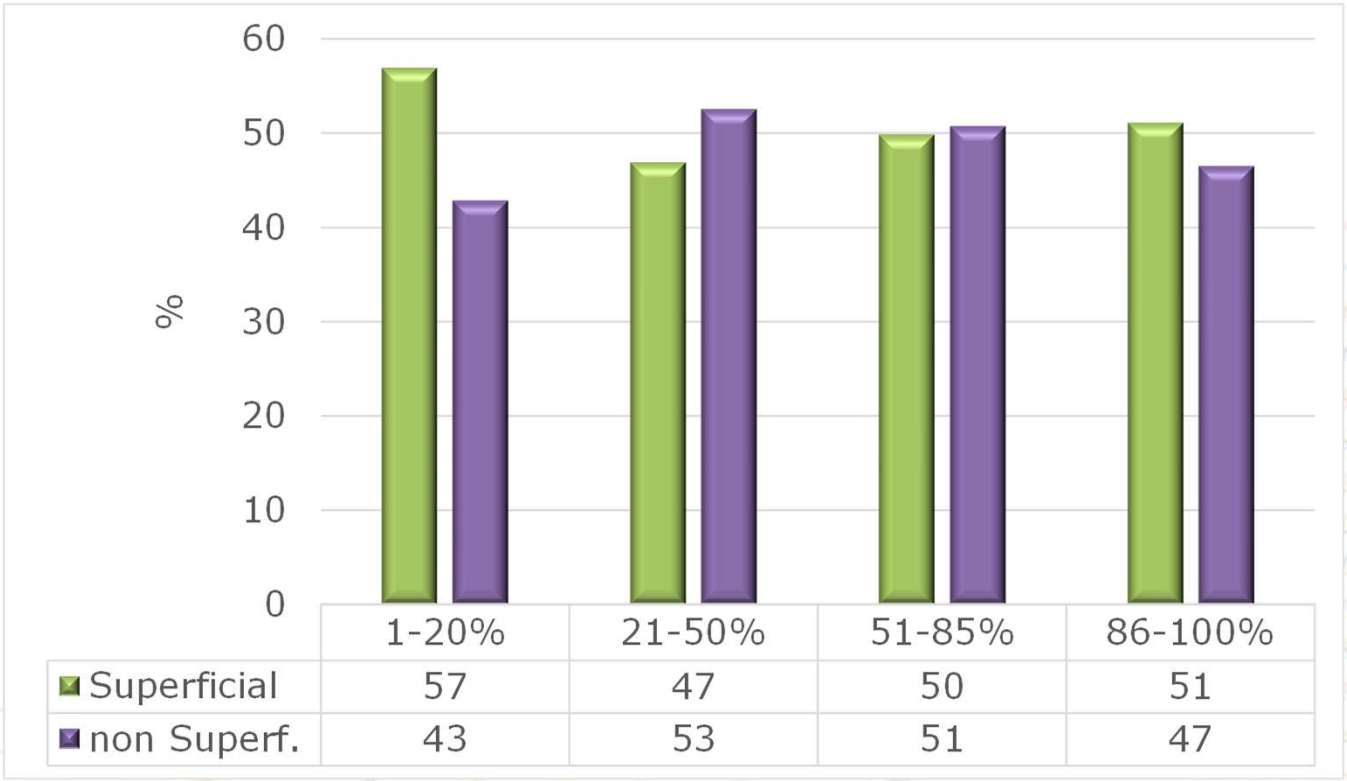
FADN irrigated farms: Irrigation systems



Irrespective to irrigation share, the most spread irrig. system is localised irrigation (highly efficient)

Source: FADN, 2020-2022

FADN irrigated farms: Water source



	1-20%	21-50%	51-85%	86-100%
Superficial	57	47	50	51
non Superf.	43	53	51	47

Groundwater (well, springs) and superficial sources are equally distributed in Southern regions

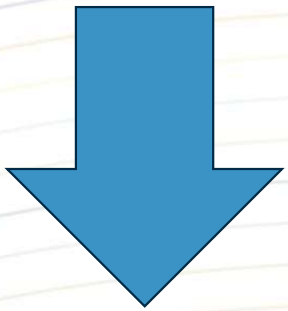
Source: FADN, 2020-2022

Analysis of farms performance

&

economic estimates of losses

due to irrigation contraction



Economic results by irrigation level and FT (euro/ha per farm)

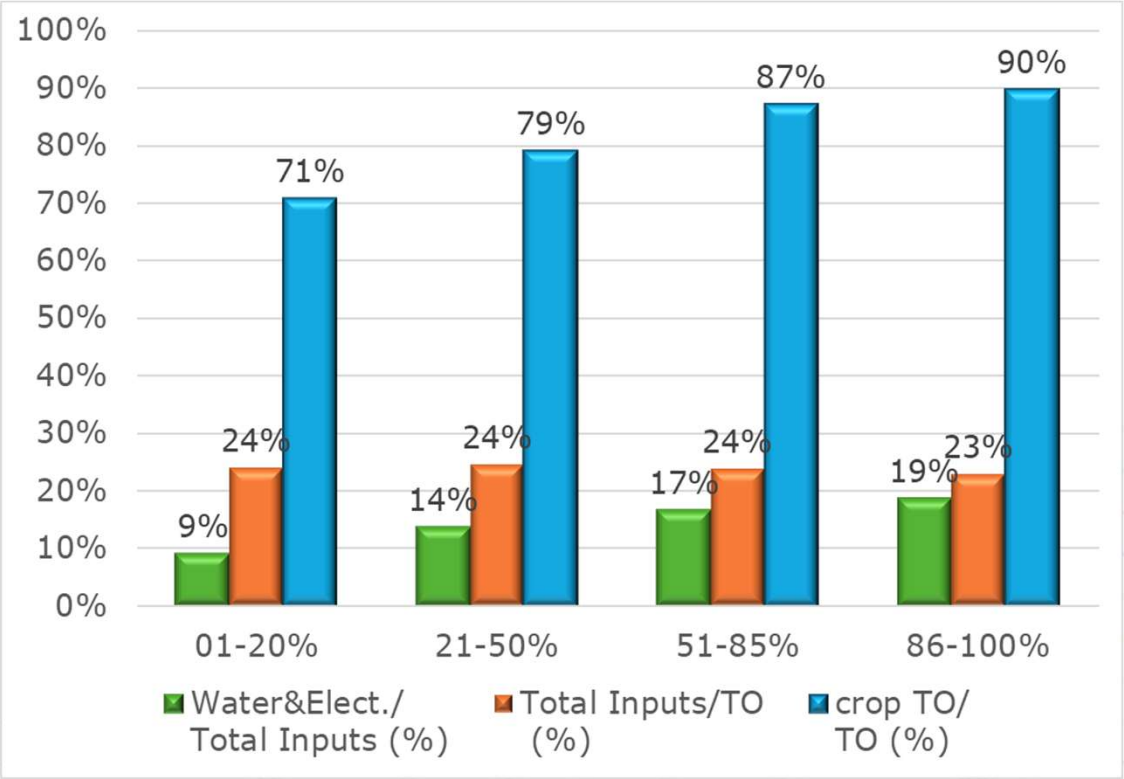
	Total Output	Crop TO	Total Inputs	Added value
Field crops	3.219	2.803	1.007	2.004
Permanent crops	3.728	3.234	767	2.684
Grazing livestock	2.708	492	784	1.827
Mixed cropping	2.861	2.505	781	1.919
All irrigated farms	3.463	2.859	819	2.407

	Total Output	Crop TO	Total Inputs	Added value
No irrigation	1.783	1.242	391	1.256
1-20%	2.082	1.473	497	1.449
21-50%	2.978	2.355	727	2.035
51-85%	4.684	4.080	1.108	3.240
86-100%	5.440	4.876	1.240	3.849

Source: FADN, 2020-2022

- Highest results in terms of crop TO per hectare in permanent crops
- Cost of irrigation is higher in permanent crops
- As expected, increasing irrigation share revenues and costs increase: TO increases more than proportionally when irrigation covers more than 50% of UAA

Direct costs by irrigation share



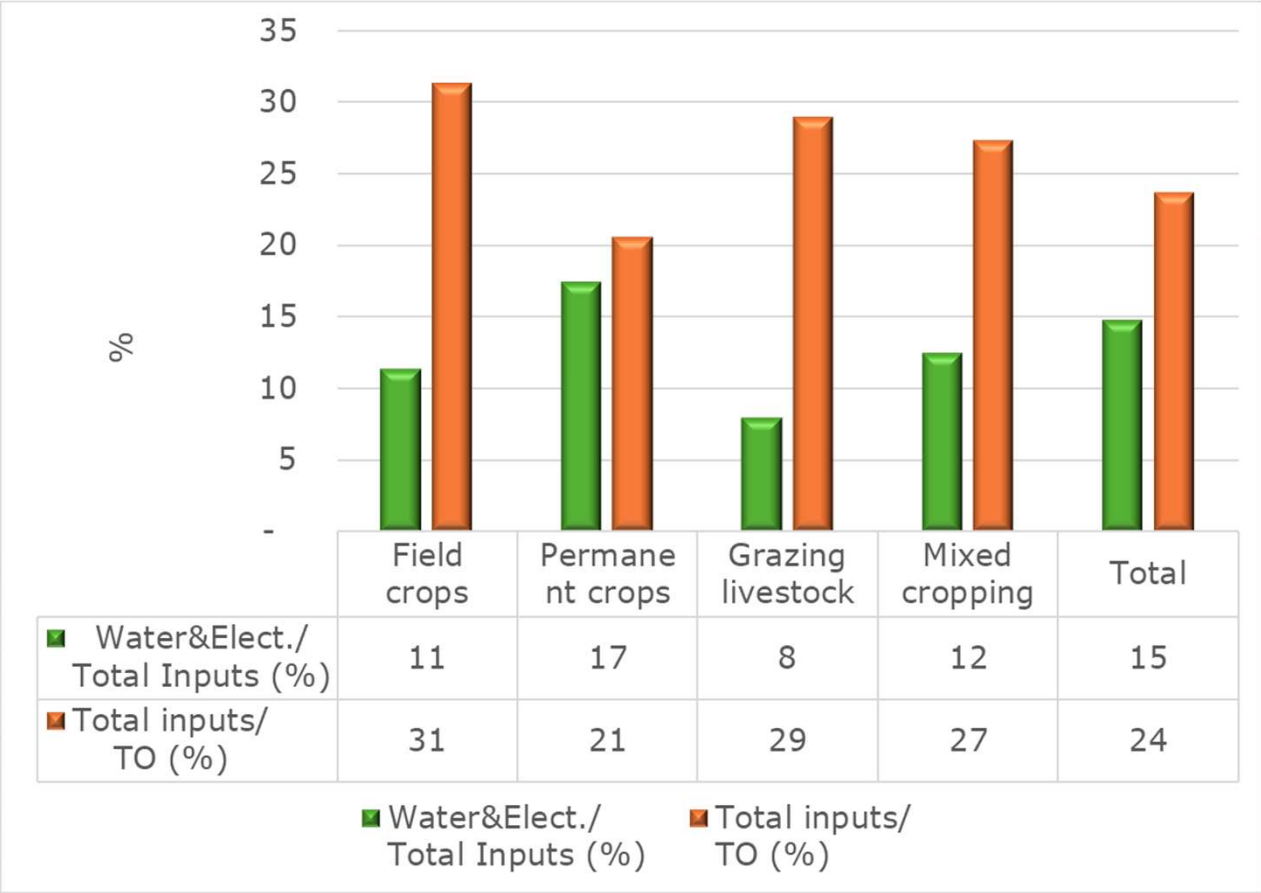
Crop TO increases significantly, while costs less than proportionally, thus gross margin improves.
Above 50% of irrigated land the costs increase more than proportionally.

Irrigation share	**Water&Electicity** euro/ha
1-20%	45
21-50%	99
51-85%	183
86-100%	230

Source: FADN, 2020-2022

Costs and Total Output by Farm Type

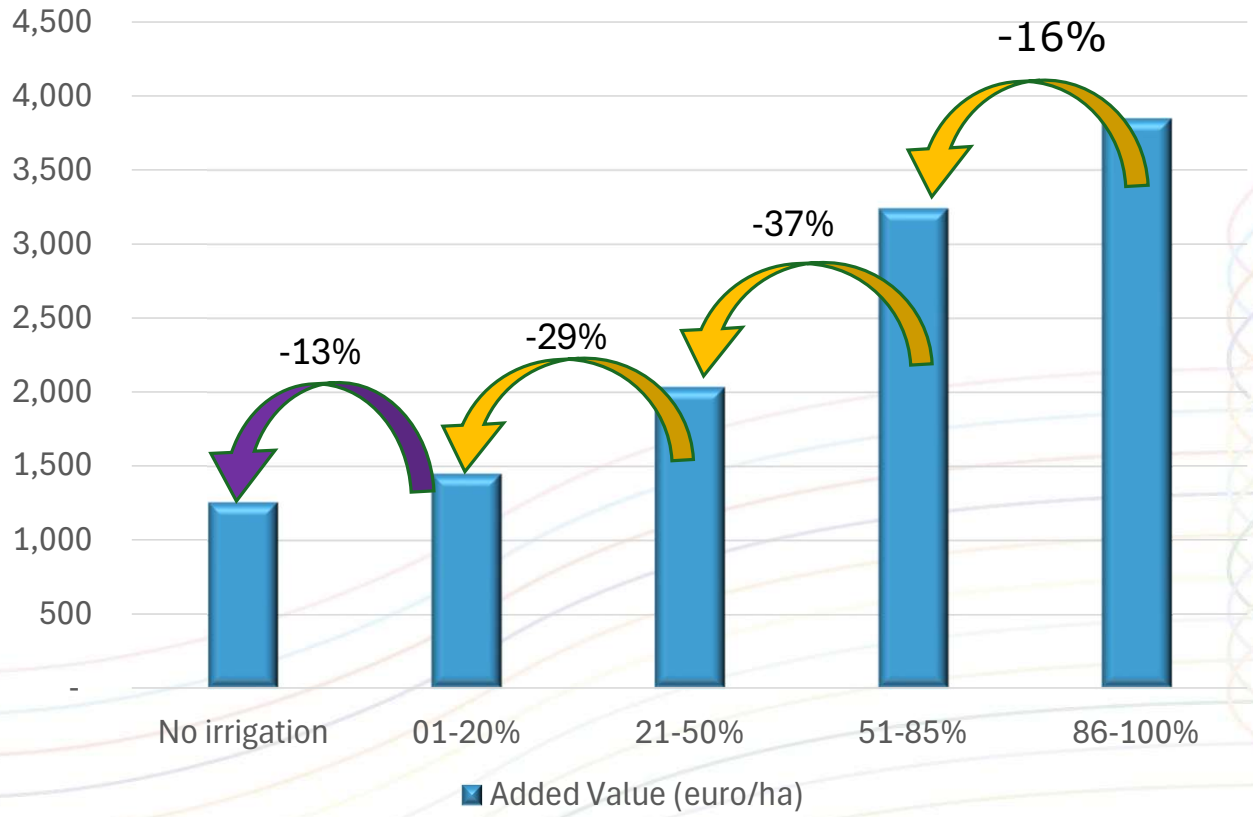
Permanent crops have the highest expenditure for water and electricity (134€/ha over 767€/ha of total inputs),
also in percentage value.



	Field crops	Permanent crops	Grazing livestock	Mixed cropping	Total
Water&Elect./ Total Inputs (%)	11	17	8	12	15
Total inputs/ TO (%)	31	21	29	27	24

Source: FADN, 2020-2022

Estimated profit loss by irrigation level



Considering a scenario of DOWNGRADING in irrigation share, the most affected farms are those with more than 50% to 85% of irrigated land.

Source: FADN, 2020-2022

Estimated profit loss by Farm Type

- Farms with field crops and mixed crops are the most vulnerable to water scarcity
- Value Added of farms with 21-51% of irrigated UAA would halve in case of decrease of water availability
- Permanent crops are less sensitive overall, except if more than half the UAA is irrigated

		Added Value (euro/ha)	AD Loss (%)	Vulnerability
Field crops + Hortic.	No irrigation	800		-
	01-20%	1.039	-23,0	low
	21-50%	2.223	-53,2	high
	51-85%	3.515	-36,8	medium
	86-100%	4.373	-19,6	low
Permanent crops	No irrigation	2.166		
	01-20%	1.909	13,4	
	21-50%	1.992	-4,2	N.A.
	51-85%	3.154	-36,9	high
	86-100%	3.793	-16,8	low
Grazing livestock	No irrigation	740		-
	01-20%	1.219	-39,2	medium
	21-50%	1.611	-24,4	low
	51-85%	3.481	-53,7	high
	86-100%	3.081	13,0	
Mixed farms	No irrigation	1.006		-
	01-20%	1.114	-9,7	N.A.
	21-50%	2.428	-54,1	high
	51-85%	3.590	-32,4	medium
	86-100%	4.672	-23,2	low

Source: FADN, 2020-2022

Estimated profit loss by administrative region

Considering a scenario of downgrading, irrigated farms located in islands would reduce added value more than mainland regions

	Added value (euro/ha)		**Profit loss (%)**	
	Mainland	Islands	Mainland	Islands
No Irrigation	1.404	998		
1-20%	1.811	1.062	-22,5	-6,0
21-50%	2.138	1.843	-15,3	-42,4
50-85%	3.425	2.933	-37,6	-37,2
86-100%	3.924	3.702	-12,7	-20,8

Source: FADN, 2020-2022

Discussion

- Climate change will impact farmers decisions on irrigation practices especially in semi-arid areas in Southern Italy
- Irrigated farms are decreasing, irrigated UAA is stable
- Irrigated crops determine good farm economic performance:
  - Highest results in terms of crop T.O. per hectare in permanent crops
  - T.O. increases more than proportionally when irrigation covers more than 50% of UAA
- In the scenario of downgrading in irrigation share the most affected farms
  - are those with more than 50% to 85% of irrigated land
  - irrigated farms located in islands would reduce added value more than mainland regions

Limits and perspectives

- LIMITS
  - The analysis focuses only on some FT and regions
  - Considering a longer time period could fit a long-term phenomena
  - FADN sample does not represent all irrigated farms
  - Low precision of FADN irrigation data
  - Environmental impact was not considered

- PERSPECTIVES
  - Improve methodology by widening the sample and introducing Statistical Matching
  - Better estimation of FADN irrigation costs
  - Statistical linkage to *Agricultural Census* to describe territorial distribution and impact of irrigation
  - Validate data with farmers interviews (*field survey*)
  - Consider the level of farms innovation
  - Explore policy interventions

Thank you for your attention

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