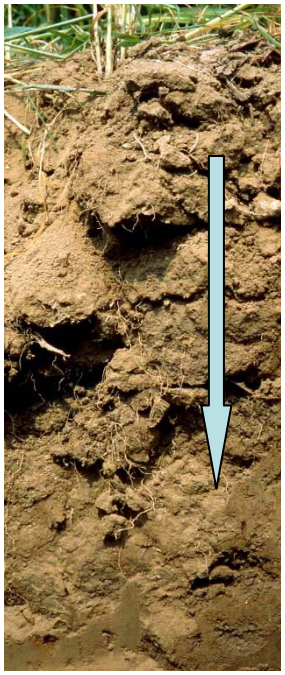
DISAFA
Università degli studi di Torino

Best management practices for efficient use of water and for preventing contamination from plant nutrients and pesticides

Aldo Ferrero, Dario Sacco

Water Balance and water excess



rainfall

evaporation,
transpiration

irrigation

runoff

crop water
uptake

internal
fluxes

variation
in SWC

leaching

drainage

DISAFA
Università degli studi di Torino

1. Increasing in water use efficiency
2. Reducing water runoff
3. Preventing environmental contamination by plant nutrients and plant protection products

DISAFA
Università degli studi di Torino

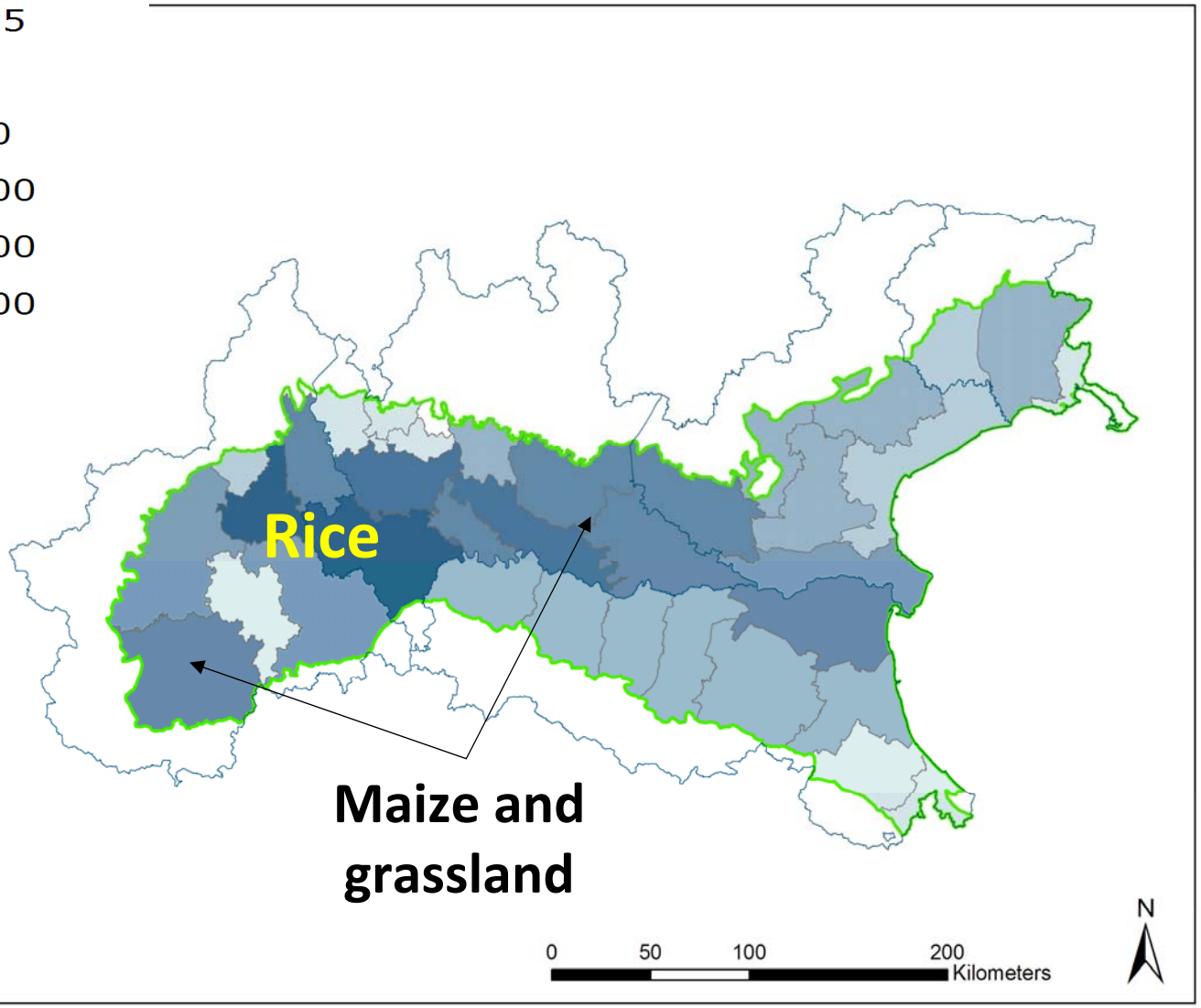
Increasing in water use efficiency

Water use in Po valley agriculture

Millions m^3

- 0,02 - 25
- 25 - 50
- 50 - 100
- 100 - 200
- 200 - 400
- 400 - 700
- > 700

ISTAT, 2010
6° Censimento
Generale dell'Agricoltura



Irrigation effect and water use efficiency

Crop	Volume	Yield		Yield reduction	Water use efficiency
		Irrigated	Rainfeed		
	mm	t ha^{-1}	t ha^{-1}	%	kg m^{-3}
Maize	187	11,8	8,7	26	1,70
Sorghum	300	8,8	8,3	20	0,70
Sunflower	200	3,5	2,7	23	0,40
Grassland	344	12	8	35	1,25
Leys	326	15	13	14	0,64
Lucerne	326	15	12	15	0,67

Giovanardi (1991), Mannini *et al*. (1986), Vecchiettini e Garagnani (1986), Grignani e Cavallero (1986), Grignani (1990), Luppi (1962), Grignani (1991).

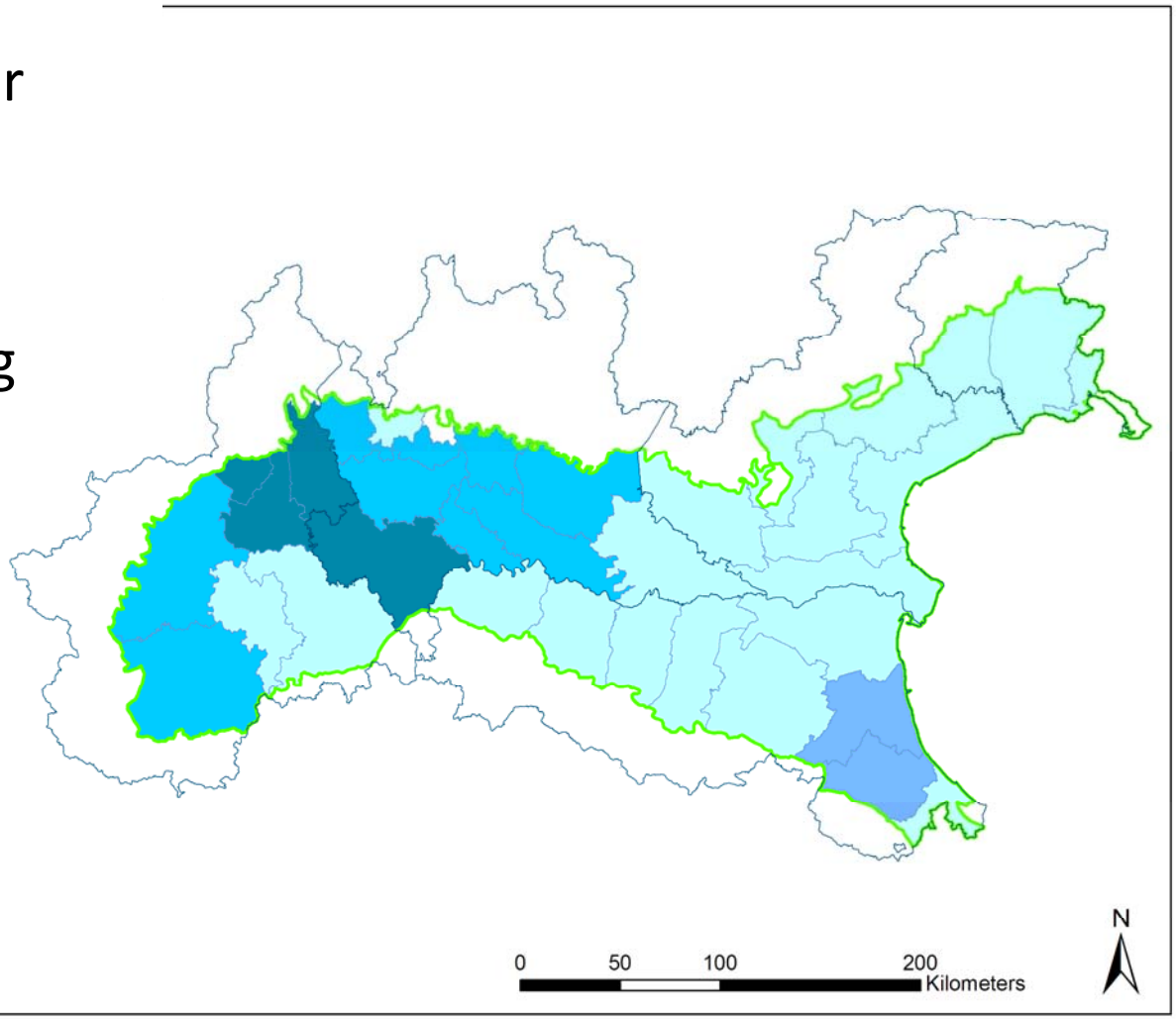
Irrigation methods in Po Valley

Sprinkler

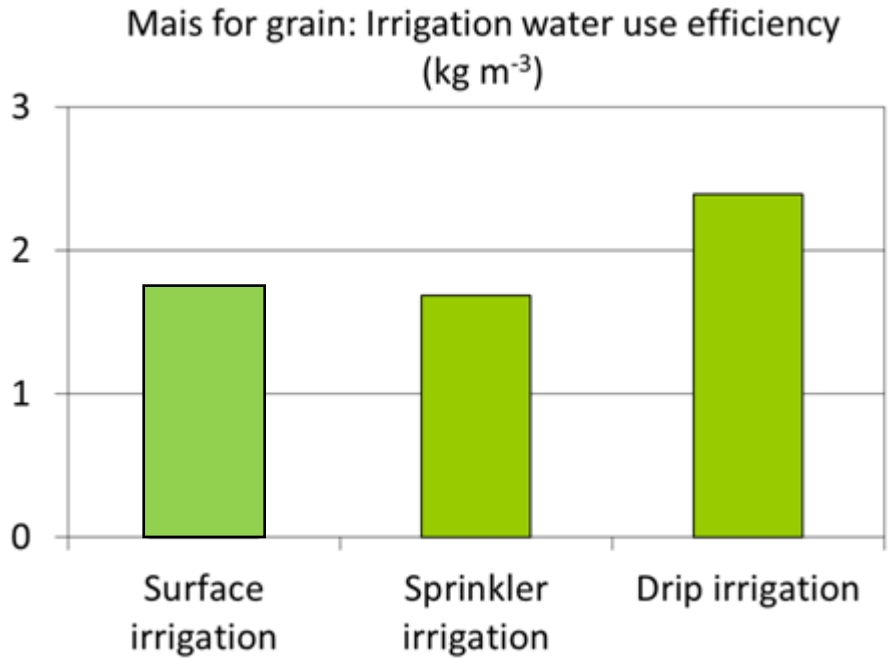
Drip

Surface

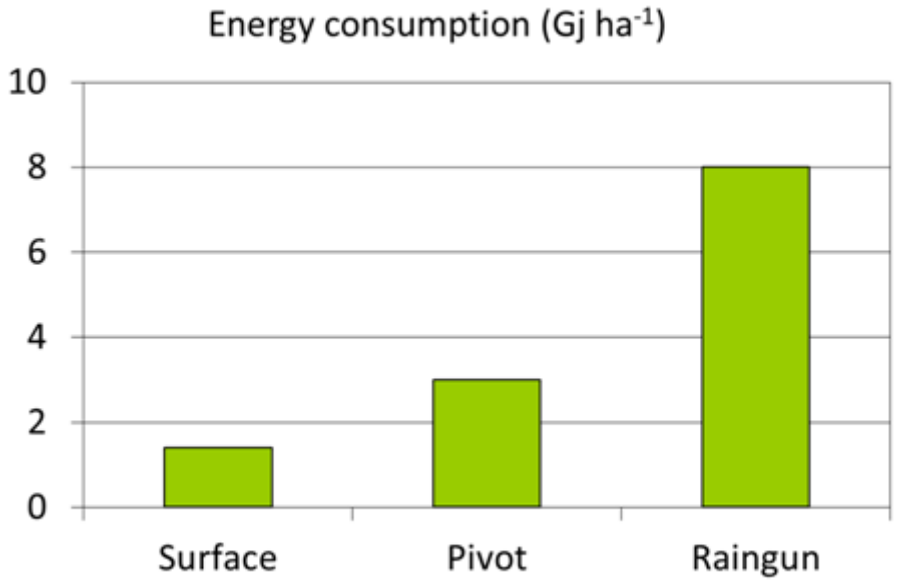
Flooding



Comparison between water use efficiency



Humphreys *et al*., 2005, Grignani et al., 2009

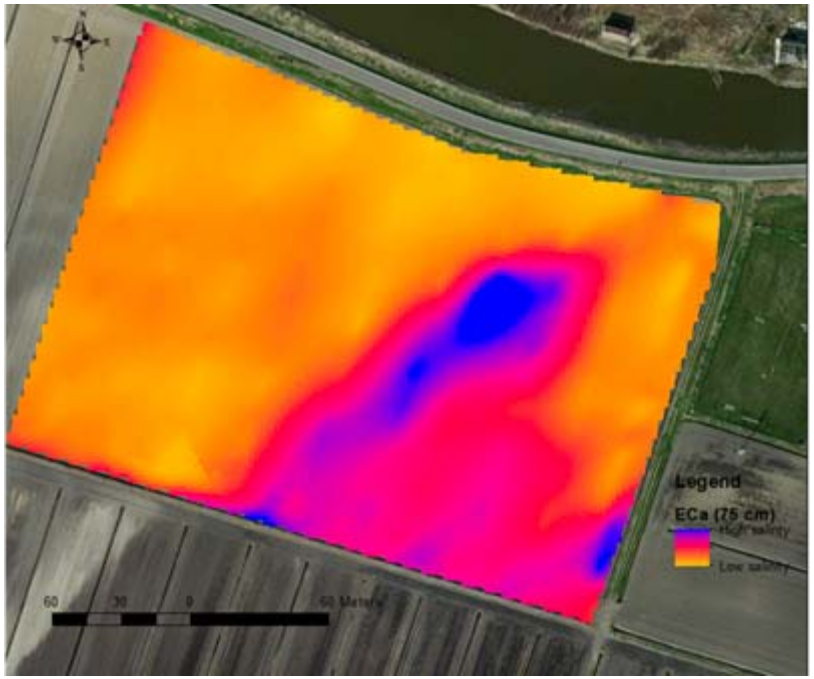


Berruto *et al*., 2009

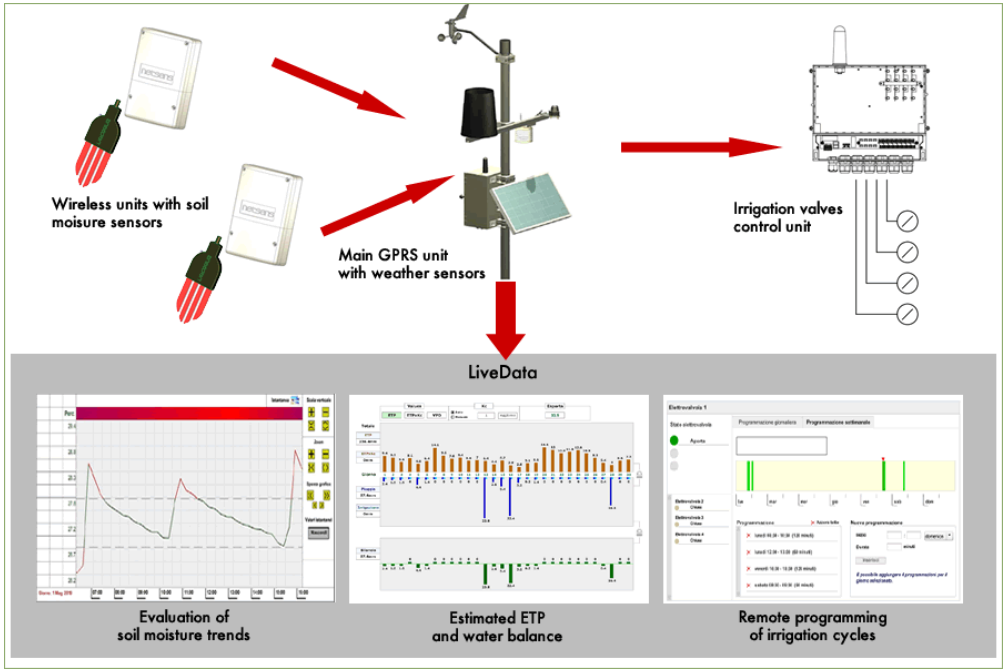
Innovation in irrigation system

Soil and crop mapping, sensors, models and precision irrigation

Picture from NETSENSE S.R.L.



Morari et al., 2015



Site specific irrigation

DISAFA
Università degli studi di Torino

Reducing water runoff

Mitigation measures: soil tillage

Reduce tillage intensity

Direct and indirect action to limit runoff

- Increase crop residues on the surface
- Reduce machinery transit and avoid plough pan

Mitigation measures: cover crops

Establish plant annual cover crops to avoid bare soil

- Fast and dense establishment of vegetation
- Abundant crop residues on the field after crop termination

Mitigation measures: vegetative buffers

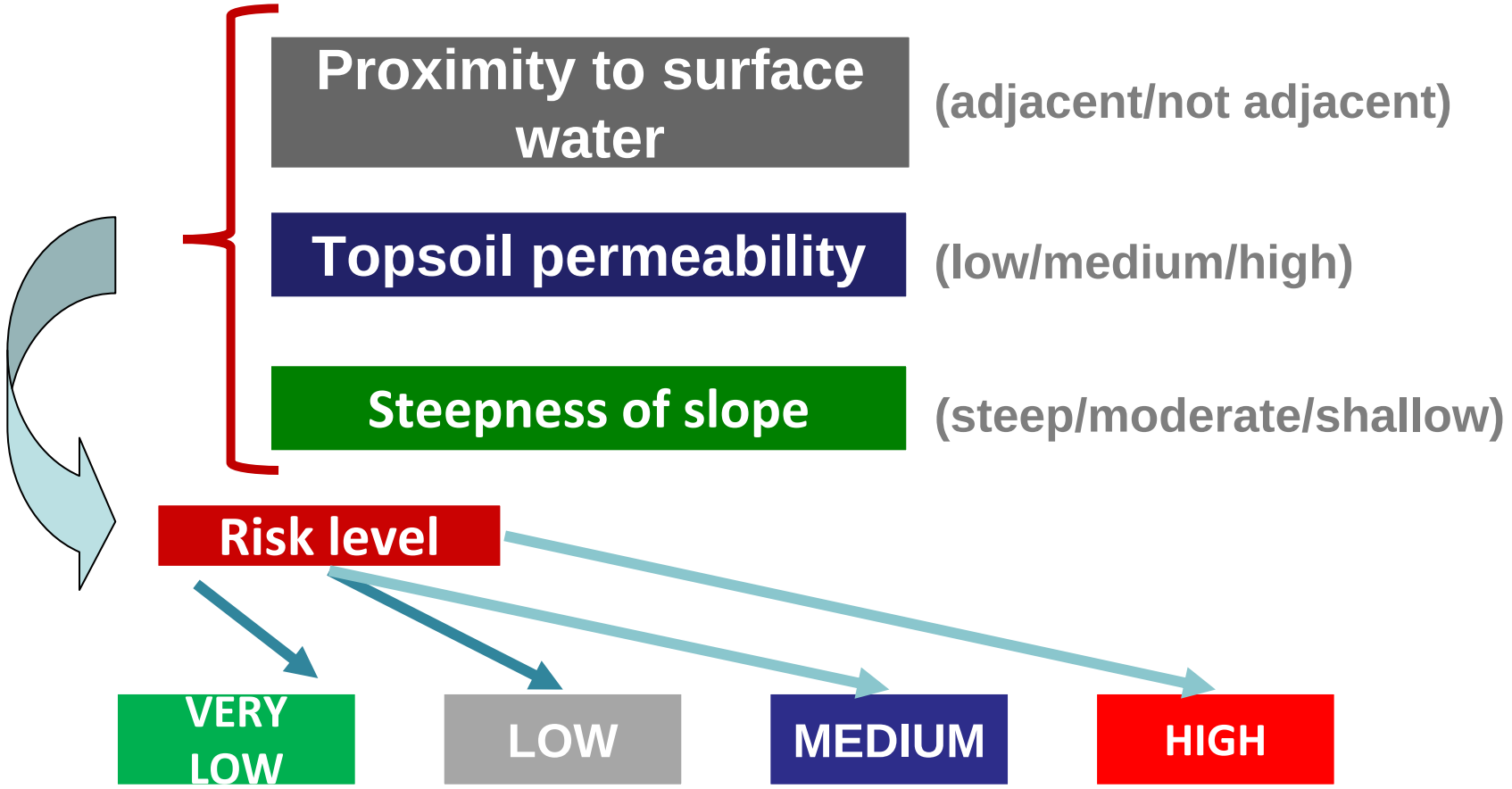
Establish or maintain in-field buffer

Slow down surface runoff and provide infiltration areas for runoff water

- Perpendicular to the runoff water flows and be part of natural vegetation (non-invasive species)
- Provide a dense vegetation cover at the downslope end of field

Dashboards and indicators

- Dashboards helps to make stepwise decisions highlighting important factors
- Decision based on major factors influencing runoff risk



DISAFA
Università degli studi di Torino

Preventing environmental contamination by plant nutrients and plant protection products

Fertigation: Increase in nutrient use efficiency

Maize

Rice

- Synchronization of nutrient supply with crop demand
- Reduction in fertilizers application due to higher nutrient efficiency
- Reduction in nutrient leaching
- Less soil compaction due to reduced machinery transit

Drip irrigation in rice

Potential increase in crop productivity

Reduce water consumption (50-70% water saving)

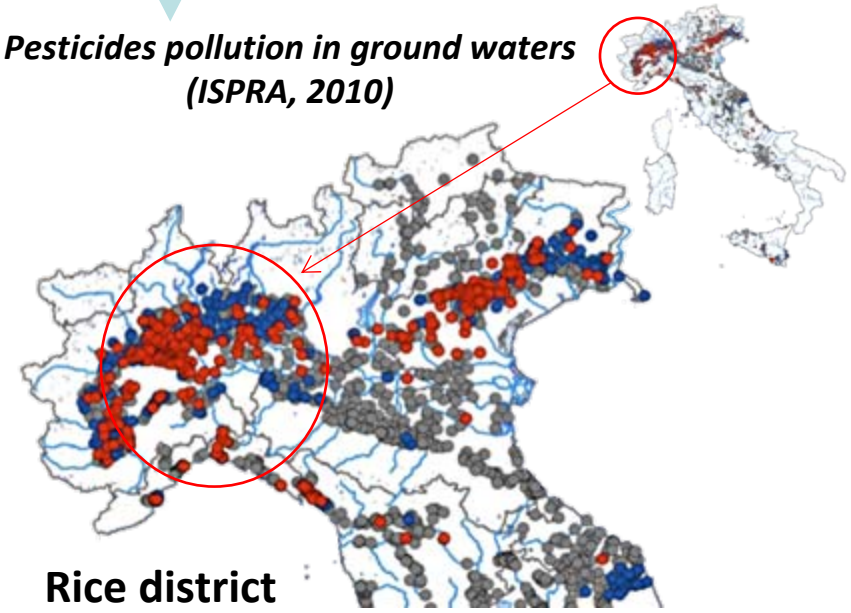
Reduce nutrients and pesticides losses

Limited uptake of hazardous metals

Extend rice cultivation in areas with soil, water and land limitations

Ongoing project in collaboration with Netafim

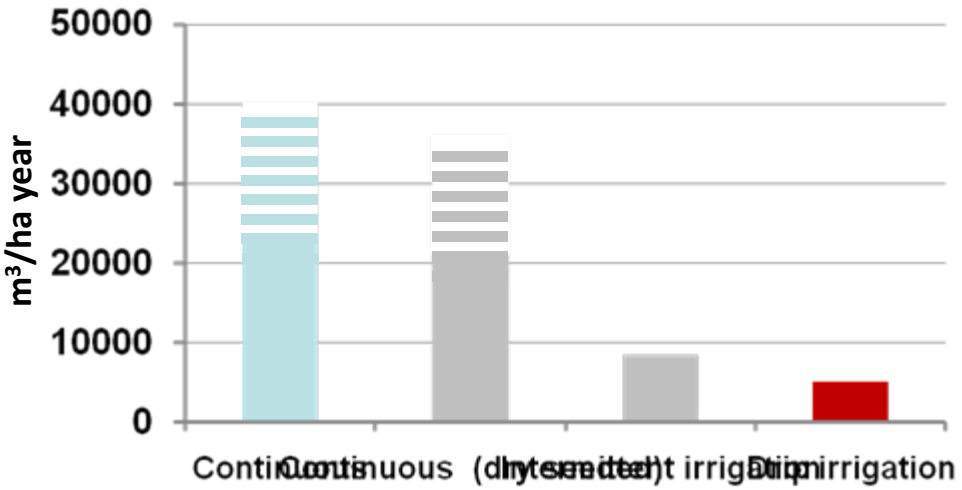
Pesticides pollution in ground waters (ISPRA, 2010)



Rice district

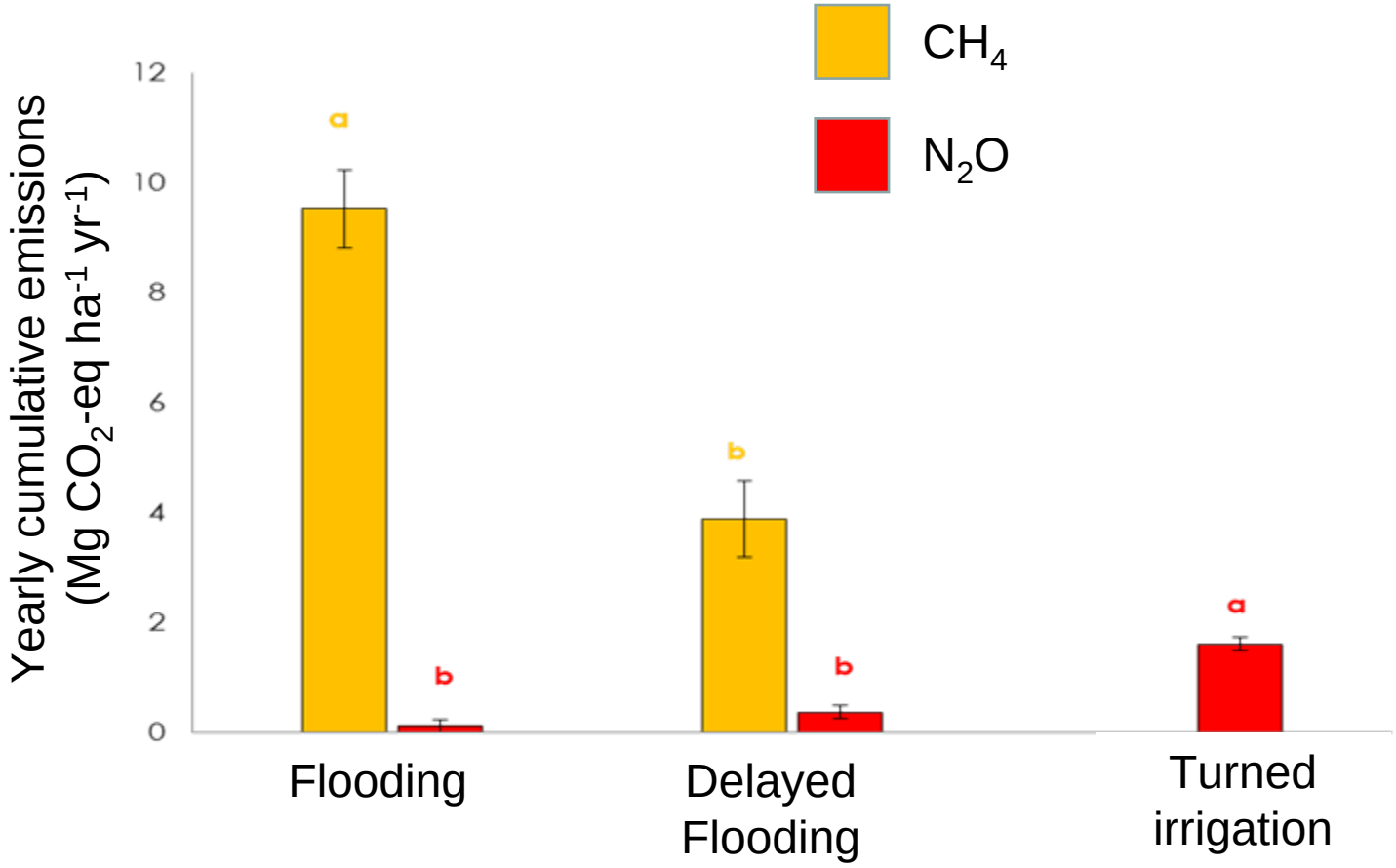
- **In red: > 0.10 µg/L**

Average water consumption over the season



Monaco and Sali, 2014, modified

Alternative irrigation on rice: GHG emissions



Bertora et al., 2015

Most relevant publications

M. Milan, A. Ferrero, M. Letey, F. De Palo, F. Vidotto, 2013. Effect of buffer strips and soil texture on runoff losses of flufenacet and isoxaflutole from maize fields. **Journal of Environmental Science And Health**, 48, 12, 1021-1033

M. Milan, F. Vidotto, S. Piano, M. Nègre, A. Ferrero, 2013. Buffer strip effect on terbuthylazine, desethyl-terbuthylazine and S-metolachlor runoff from maize fields in Northern Italy. **Environmental Technology**, 34, 71-80.

M. Milan, F. Vidotto, S. Piano, M. Nègre, A. Ferrero, 2012. Dissipation of propanil and 3,4 dichloroaniline (3,4 DCA) in three different rice management systems. **Journal of Environmental Quality**, 41, 1487-1496.

F. Vidotto, A. Ferrero, O. Bertoia, M. Gennari, M., A. Cignetti, 2004. Dissipation of pretilachlor in paddy water and sediment. **Agronomie**, 24, 473-479.

Z. Miao, M. J., Cheplick, M.W.Williams, M. Trevisan, L. Padovani, M. Gennari, A. Ferrero, F. Vidotto, E. Capri, 2003. Simulating Pesticide Leaching and Runoff in Rice Paddies with the RICEWQ–VADOFT Model. **Journal of Environmental Quality**, 32, 2189–2199.

A. Ferrero, F. Vidotto, Gennari M., M. Nègre, 2001. Behavior of Cinosulfuron in Paddy Surface Waters, Sediments, and Ground Water. **Journal of Environmental Quality**, 30, 131-140.

TOPPS Prowadis: Best Management Practices to reduce water pollution with plant protection products from run-off and erosion. http://www.topps-life.org/

Alluvione, F., Bertora, C., Zavattaro, L., Grignani, C., 2010. Nitrous Oxide and Carbon Dioxide Emissions Following Green Manure and Compost Fertilization in Corn. **Soil Science Society of America Journal,** 74, 384.

Grignani, C., Zavattaro, L., Sacco, D., Monaco, S., 2007. Production, nitrogen and carbon balance of maize-based forage systems. **European Journal of Agronomy** 26, 442–453.

Zavattaro, L., Monaco, S., Sacco, D., Grignani, C., 2012. Options to reduce N loss from maize in intensive cropping systems in Northern Italy. **Agriculture, Ecosystems & Environment** 147, 24–35.

Zhao, Y., De Maio, M., Vidotto, F., Sacco, D., 2015. Influence of wet-dry cycles on the temporal infiltration dynamic in temperate rice paddies. **Soil and Tillage Research** 154, 14–21.

Sacco, D., Cremon, C., Zavattaro, L., Grignani, C., 2012. Seasonal variation of soil physical properties under different water managements in irrigated rice. **Soil and Tillage Research** 118, 22–31.