# Adaptation to Climate Change in Agriculture
# Case studies and policies in Italy
# "Impacts and responses in the water sector"

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# 1. Introduction

- **Climate Change (CC):** in the last decades:

  → increased temperatures and changes in rainfall patterns (decreasing of water availability and different time /space distribution of rainfall);

  → increased intensity/frequency of extreme events (drought and floods, heat waves, etc.).

**What to do**: national problem,

→ implementation of major works/contributions;

→ adjustment of policies for adaptation/mitigation.

# 2. Impacts of CC on water resources and agriculture

- **Meteorological parameters of major interest from the agronomic point of view:**
  - Temperature;
  - Rainfall;

- **Short-term impacts**: influence on water availability and agricultural practices;

- **Long-term effects:**
  - worsening of the marginality of many agricultural systems in vulnerable regions;
  - high uncertainty in decision-making for farmers;
  - uncertainty on agricultural production (food security and quality concerns).

# 3. Importance of water resources for Italian agriculture

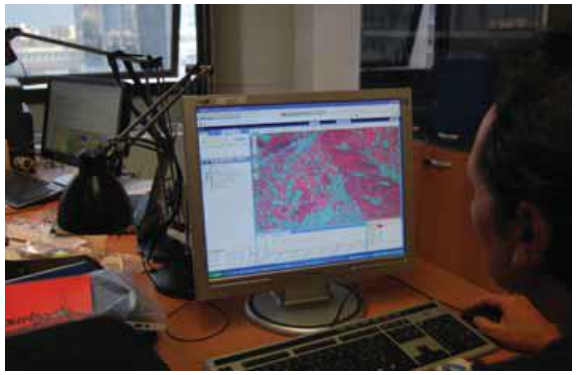
- **Irrigated production**:
  - approximately 80% of the exported Italian vegetable production comes from irrigated crops;
  - livestock and diary sector based on irrigated pasture production;

- **Irrigation** has a **multifunctional role** on the territory: **positive external effects**
  - e.g.. protection of soil from erosion and desertification, conservation of migratory protected species; quickening of the natural pattern (biodiversity, water quality), groundwater recharge, and recreational purposes and cultural landscape heritage, historical and architectural heritage.

- Thus: **water is used** in agriculture, **NOT "consumed"**:
  providing **FOOD CHAIN and environmental public goods.**

# 4. Water saving in agriculture

- **Irrigation advisory services;**
- **Knowledge on irrigation supporting decision making: IRRIFRAME and SIGRIAN – INEA;**
- **Wastewater reuse for agriculture – irrigation with alternative water sources .**



# 5. Irrigation advisory services

- **Goal:** improvement of water management to achieve higher/same yields and water saving through the water requirements assessment;

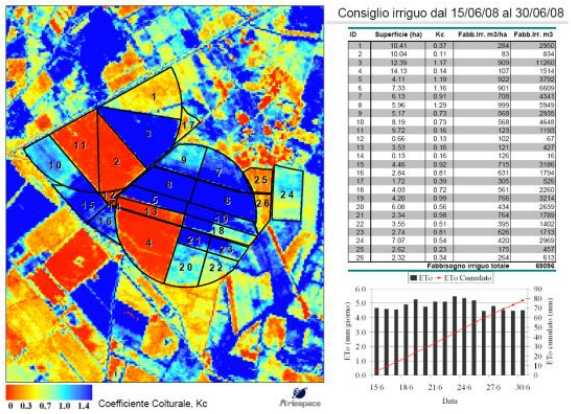
- **Users**: - reclamation and irrigation consortia (collective irrigation);
  - farmers;

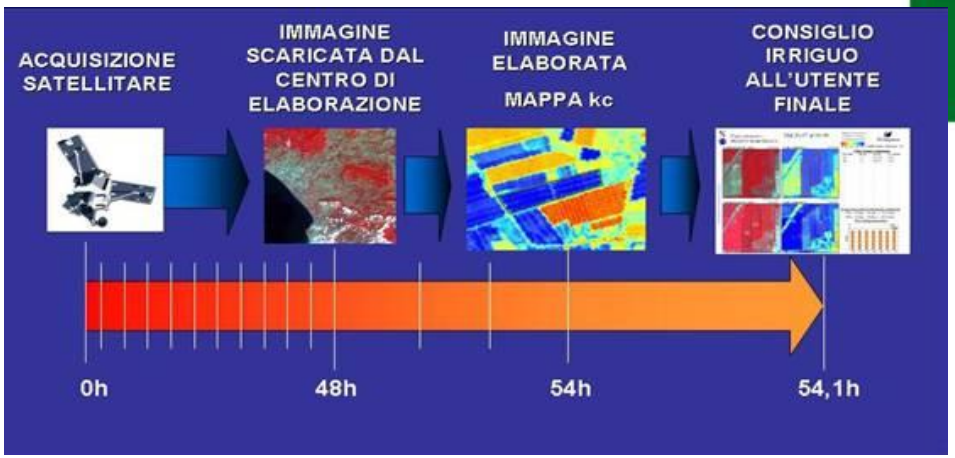
- **Daily/weekly information and communication between the consortium and the farmer:**
  - **tool:** internet, e-mail, text messages;
  - **information**: when to irrigate and how much water.

- **Methodology** based on satellite images, weather climate data, geographic information systems, cost-benefit analysis, water balance models and irrigation requirements calculations.

# 5b. European research project SIRIUS (INEA)

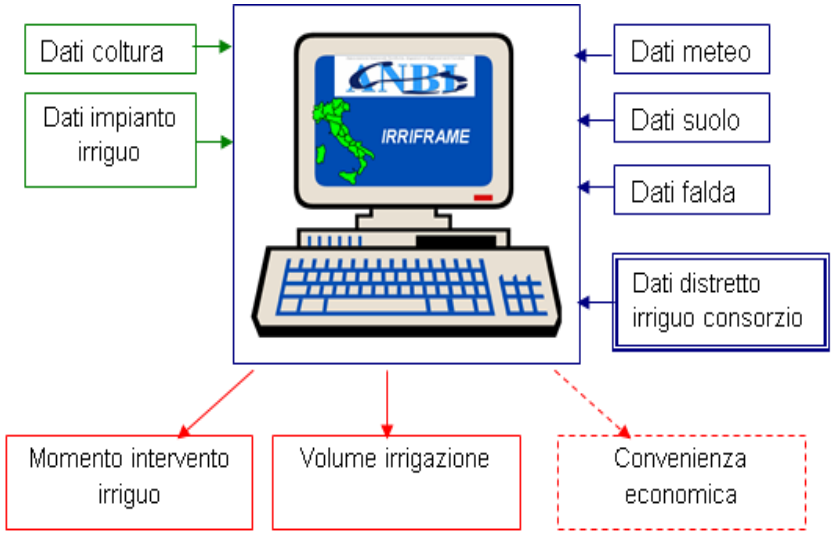
- **Pilot Area in Italy:** Consortium Sannio-Alifano;
- **Acquisition of multispectral satellite data** (LANDSAT TM, SPOT) and "pre-processing" of images (radiometric correction, geo-referencing);
- Calculation of **vegetation indices** (NDVI, WDVI, LAI);
- Acquisition of **agro-meteorological data** from stations next monitored area;
- Production of **maps of potential evaportranspiration** (FAO methodology)
- Determination of **crop coefficients** (Kc);
- Calculation of **irrigation requirement for each crop** (maps with weekly time scale)

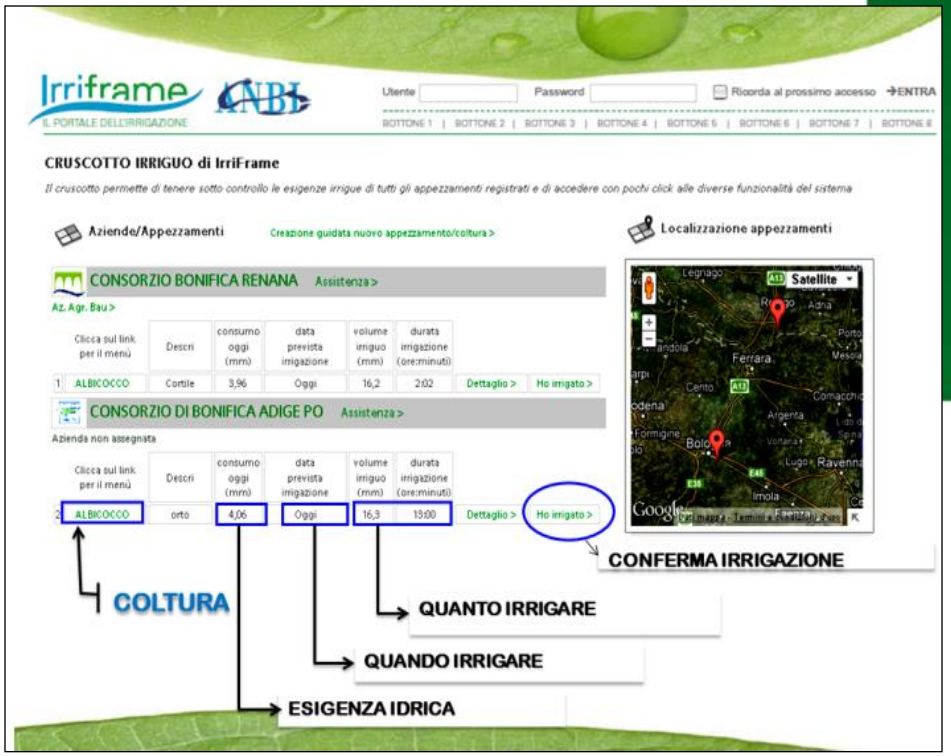


# 5c. IRRIFRAME national Service (ANBI-CER)

- Service **available** for all irrigation consortia, really used by 36 located in 11 Italian regions;
- **Algorithms for water balance (soil/plant/atmosphere)**: calculation of the water content in the soil, crop growth (LAI and root depth), water requirement of the crop;
- **Output: best moment and quantity of water for irrigation** (text messaging to farmers);



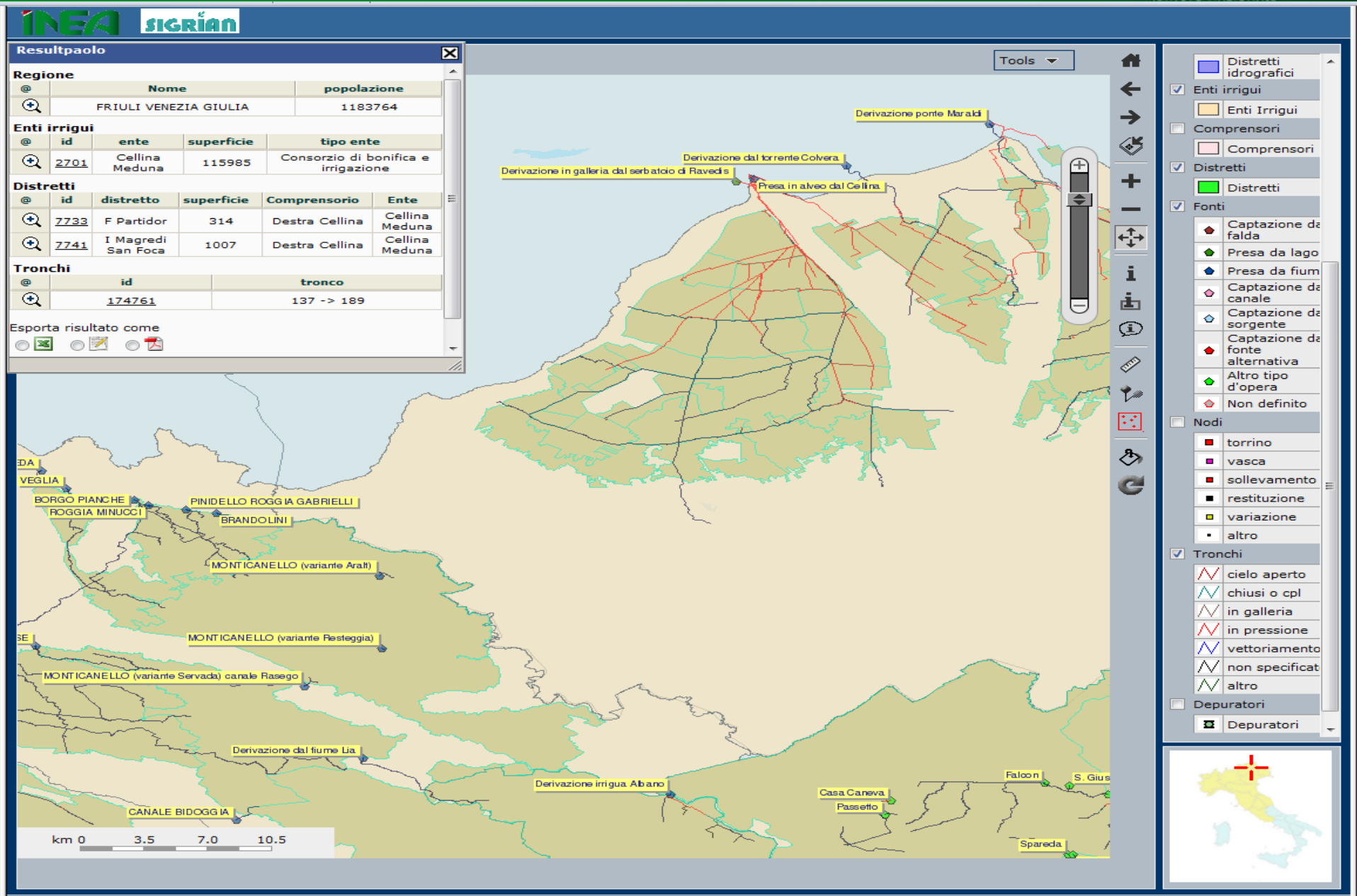



# 5d.Integration between IRRIFRAME and SIGRIAN from 2014

- **SIGRIAN** - National information system for water management for agriculture:
  - data on irrigation (served and irrigated areas, networks, management characteristics, etc.) supporting:
    - water planning and programming ;
    - regional and sub-regional actions for irrigation;
    - River basin Management plans;
- **Integration SIGRIAN/IRRIFRAME:**

  **National-regional-river basin level/local-farm level.**

# 5d. Integration SIGRIAN/IRRIFRAME



# 6. Wastewater reuse for agriculture

- **Reuse of treated wastewater → qualitative and quantitative integrated protection goals :**
  - production of additional and non-conventional water resources;
  - reduction of surface and groundwater abstraction;
  - reduction of polluters discharged in to water bodies.

- **Potential impacts and main concerns on economic-technical feasibility:**
  - **environmental/agronomic**: runoff into the groundwater (salinity, metals and organic substances);
  - **sanitary**: possible presence of bacteria, viruses, parasites;
  - **infrastructural**: re-use standards required by the legislation implies plants' adaptation; structural connection between plants and irrigation networks;
  - **economic**: cost-opportunity, scarcity value, cost-benefits of investments.

# 6b. AGROSCENARI project (INEA)

- **AGROSCENARI Project** http://www.agroscenari.it/

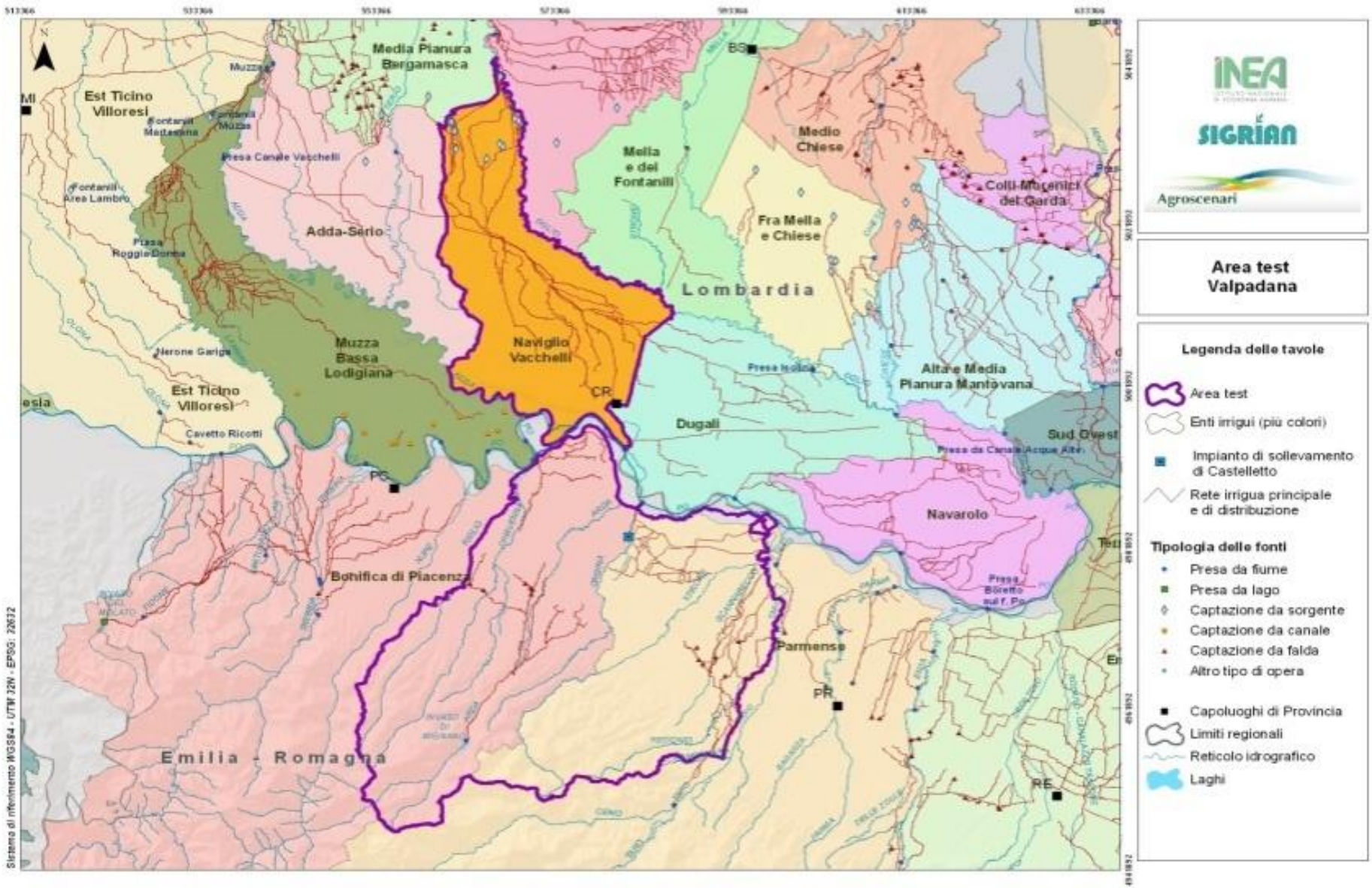
  9 research lines→ **INEA line 9b**:

  - impacts and effects of scenarios of CC on agriculture/irrigation systems;
  - policy instruments to be adopted (mitigation and adaptation).

- **Pilot area** → Val Padana (Province of Cremona, Bergamo, Parma and Piacenza).

- **Analysis of these aspects of wastewater reuse for agriculture in the basin of Val Padana:**
  - **Technical and economic evaluation with a MULTI-CRITERIA ANALYSIS of several alternative hypotheses of reuse associated with the different investments for treatment plants and irrigation networks;**
    - **Data from SIGRIAN.**

# 6b. AGROSCENARI project (INEA)



# 6b. AGROSCENARI project (INEA)

- **Multi-criteria Model**

  Criteria against which was rated the feasibility:

  Factors: Distance from water bodies; Vulnerability of aquifers;

  Aridity Index De Martonne; Distance from urban centers;

  Construction type network;

  Constraints: Distance from treatment plants;

  Irrigation requirements of the areas;

- **Assessment of the feasibility**

  Usability maps

- **Cost-Benefits Analysis of various hypotheses (in suitable areas)**

  benefits >> costs

# Considerations - Adaptation actions

- Conversion of **irrigation systems** with lower water consumption and increased efficiency (**sprinklers and drip irrigation**);

- **Irrigation network**: where possible, spreading of the most modern and efficient types as under pressure networks;

- **Storage** like reservoirs and hills lakes;

- **Wastewater reuse for agriculture – irrigation with alternative water sources**

- **Irrigation advisory services**

# THANK-YOU FOR THE ATTENTION

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