

Adaptation to Climate Change in Agriculture

Case studies and policies in Italy

“Impacts and responses in the water sector”

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INEA

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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 dairy 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**.

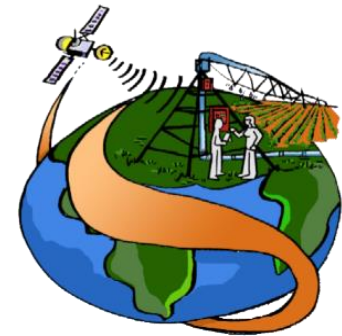
4. Water saving in agriculture

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



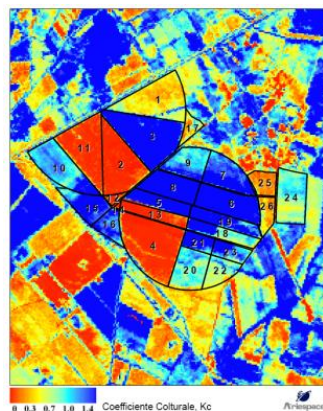
5. Irrigation advisory services

- **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.



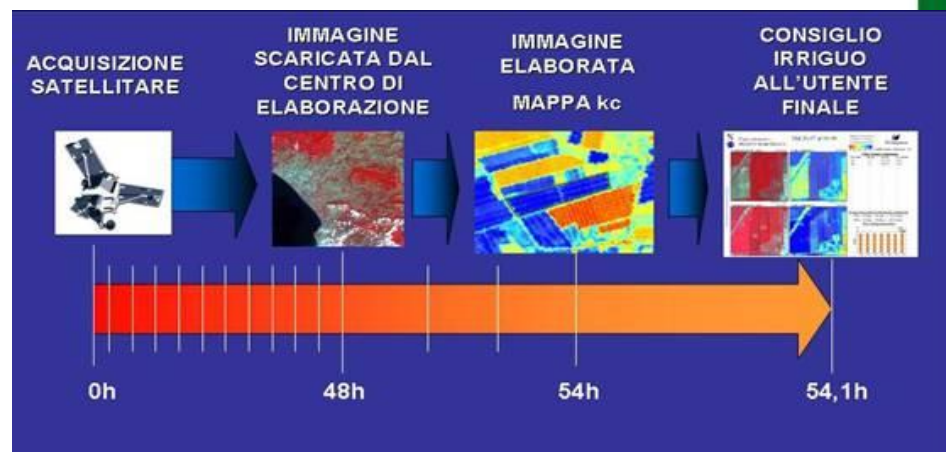
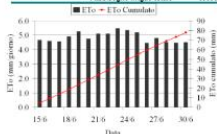
5b. European research project SIRIUS (INEA)

- **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, WDV, LAI);
- Acquisition of **agro-meteorological data** from stations next monitored area;
- Production of **maps of potential evapotranspiration** (FAO methodology)
- Determination of **crop coefficients** (K_c);
- Calculation of **irrigation requirement for each crop** (maps with weekly time scale)



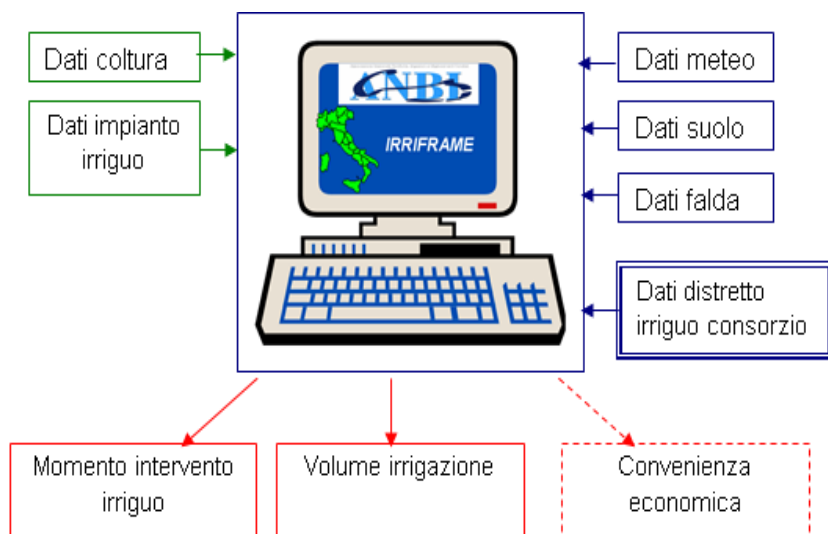
Consiglio Irriguo dal 15/06/08 al 30/06/08

ID	Superficie (ha)	K_c	Fabb. in m ³ /ha	Fabb. in m ³
1	18.41	0.50	244	4496
2	10.04	0.11	83	834
3	12.38	0.14	369	4540
4	14.13	0.14	627	8854
5	4.11	1.16	920	3782
6	7.23	1.16	957	6929
7	6.13	0.91	708	4344
8	5.96	1.29	895	5305
9	5.17	0.73	364	1896
10	8.19	0.73	595	4840
11	9.72	0.16	125	1195
12	0.66	0.13	122	87
13	3.03	0.16	151	427
14	0.13	0.16	120	16
15	4.46	0.92	715	3196
16	2.54	0.97	631	1704
17	7.72	0.93	365	2826
18	4.03	0.72	361	1450
19	4.00	0.99	740	2954
20	6.08	0.55	454	2755
21	2.34	0.66	764	1786
22	3.55	0.51	395	1402
23	2.74	0.81	828	2273
24	7.07	0.54	420	2969
25	3.60	0.28	171	607
26	2.32	0.55	204	517



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);



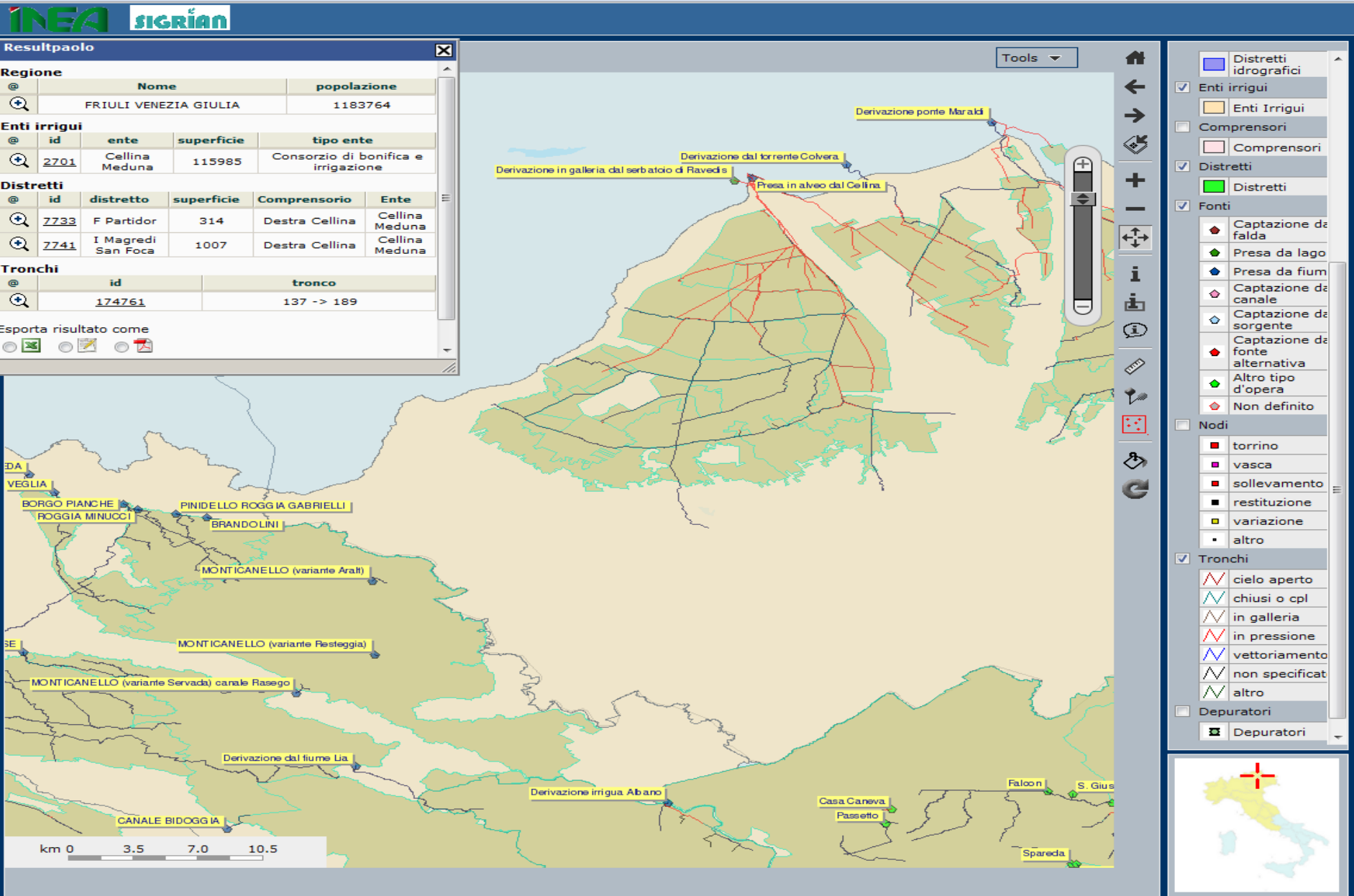
The screenshot shows the IRRIFRAME web portal. At the top, there is a login section with fields for 'Utente' and 'Password', and a 'Ricorda al prossimo accesso' checkbox. Below the login section, there are navigation buttons labeled 'BOTTONE 1' through 'BOTTONE 8'. The main content area is titled 'CRUSCOTTO IRRIGUO di IrriFrame' and includes a description: 'Il cruscotto permette di tenere sotto controllo le esigenze irrigue di tutti gli appezzamenti registrati e di accedere con pochi click alle diverse funzionalità del sistema'. The interface is divided into two main sections: 'Aziende/Appezzamenti' and 'Localizzazione appezzamenti'. The 'Aziende/Appezzamenti' section displays a table of irrigation data for two consortia: 'CONSORZIO BONIFICA RENANA' and 'CONSORZIO DI BONIFICA ADIGE PO'. The table columns include 'Descriz', 'consumo oggi (mm)', 'data prevista irrigazione', 'volume irriguo (mm)', and 'durata irrigazione (ore:minuti)'. The 'CONSORZIO DI BONIFICA ADIGE PO' section shows a table with two rows of data. The first row is for 'ALBICOCCO' in 'orto' with a consumption of 4.06 mm and a predicted irrigation date of 'Oggi'. The second row is for 'ALBICOCCO' in 'orto' with a consumption of 16.3 mm and a predicted irrigation date of '15/08'. The 'Localizzazione appezzamenti' section shows a map of the area with a red pin indicating the location of the irrigation system. The bottom of the interface features a 'CONFERMA IRRIGAZIONE' button and a 'COLTURA' label.

	Descriz	consumo oggi (mm)	data prevista irrigazione	volume irriguo (mm)	durata irrigazione (ore:minuti)
1	ALBICOCCO	Cortile	Oggi	16,2	202
2	ALBICOCCO	orto	Oggi	16,3	1500

- **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

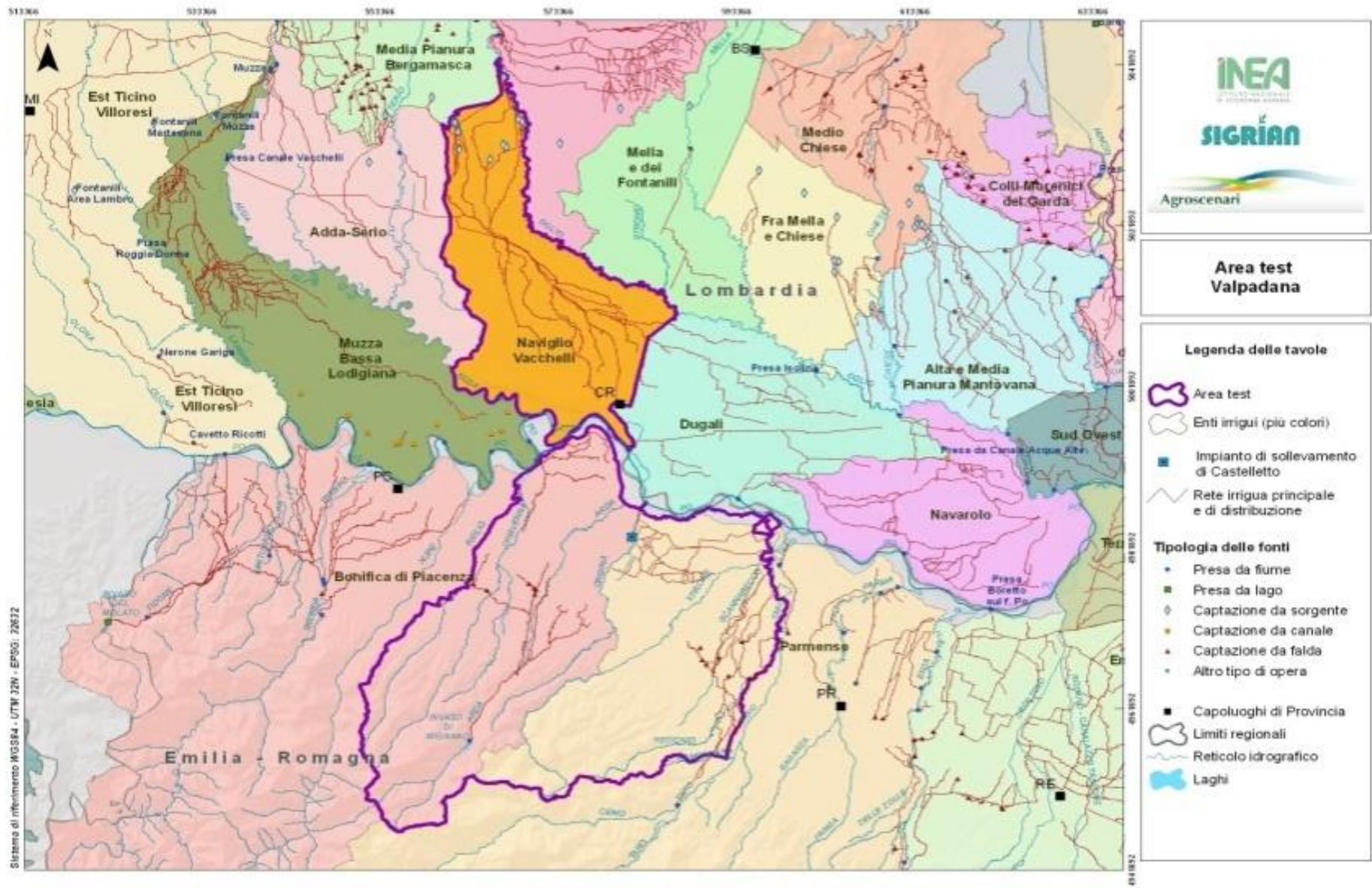
- **Reuse of treated wastewater → qualitative and quantitative integrated protection goals :**
 - production of additional and non-conventional water resources;
 - reduction of surface and groundwater abstraction;
 - reduction of polluters discharged in to water bodies.

- **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)



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➤ **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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