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Socio-hydrogeological approach for the identification of pollutant fluxes towards Mediterranean lagoon hydrosystems

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Coastal Mediterranean lagoons are at the **interface** between continental and marine environments, they also represent the **ultimate collector** of hydrological and hydrogeological watersheds. They are fragile ecosystems and usually **groundwater dependent**. Coastal hydrosystems are threatened by increasing anthropogenic pressures inducing **pollutant fluxes** within the watershed, damaging water bodies **quality**.

However coastal Mediterranean lagoons hydrogeological functioning is **poorly investigated**, damaging their management. **Socio-hydrogeology** allows, in an **inter- and transdisciplinary** way to clarify the often complex relationships linking the **processes behind pollutant fluxes** within the hydrogeological watershed and their **impact on the lagoon's water quality**. This approach integrates both **social and economic components** into hydrogeological investigations.

Study site

The **Biguglia Lagoon** (Northern Corsica) is the largest wetland of the island. The site has numerous protection status like **RAMSAR site**, **Nature Reserve** and **Natura 2000 site**.

The watershed has a surface of 182 km² it is drained by the **Bevinu River**. The northern part is formed by **lustrous schist** formation and the plain is composed of **Quaternary alluvial deposits**, corresponding to the **main aquifer of the area**. The catchment is **highly anthropised** ~ 76 000 inhabitants (*INSEE, 2018*). The aquifer is used for the drinking water supply of the urban area.

Several types of **pollutions** have been identified in the different water bodies of the watershed. Among them, **pesticide pollution**, which source processes are **still unknown**. The socio-hydrogeological approach aims at identifying the origin of this pollution in relation to the **water use** and **land use evolution** on the watershed.



Figure 1 : Aerial view of the Biguglia lagoon watershed

Socio-hydrogeological approach

I. Questionnaire

- **Semi-structured** questionnaire (53 q°)
- Structured around **4 main problematics** (Fig.3)
- Submitted to **wells and boreholes owners** and to **local stakeholders**
- Developed into two versions : **paper and online**

II. Field campaign

- Socio-hydrogeological investigations (**field survey + sampling campaign**)
- Sampling of **pesticides** and screening analysis of **240 molecules and metabolites**
- Carried out in spring 2021, during 3 weeks



III. Geochemical and pesticides analyses

- Cartography of the **geochemical signal on the watershed** using the stable isotopes of the water molecule ($^2\text{H}/^{18}\text{O}$) and **geochemical analyses** (major cation and anion analyses and trace elements)
- Developing **mixing models** to understand the aquifer behavior
- **Pesticides analyses** to identify the vulnerability of the hydrosystem facing this pollution => **unprecedented on the watershed**

IV. Correlation between the field survey and the hydrogeochemical and pesticides analyses to :

- Identify the **source processes** of the pesticide pollution
- Understand the **archiving capacity** in terms of pollution of the hydrosystem and **return** of these pollution to the natural environment
- Link the groundwater and lagoon water **quality** to the land use on the watershed

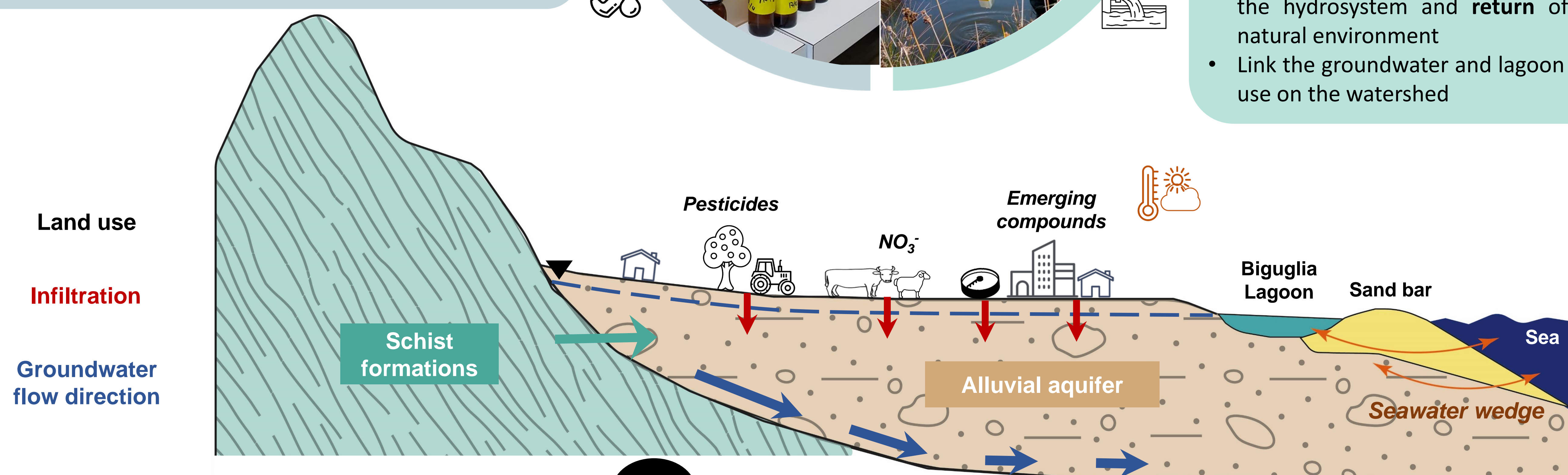


Figure 2 : The Biguglia hydrosystem and pollution fluxes

Results and perspectives

Water use

Do you own a well or a borehole ?
☐ Yes ☐ No

How often do you use the water from your well / borehole ?

- ☐ Daily
- ☐ Seasonal
- ☐ Rarely

Land use evolution in time

What type of land use do you have on your field?

With what type of molecules do you usually treat your crops or garden?

- ☐ Natural molecules
- ☐ Phytosanitary molecules
- ☐ No molecules

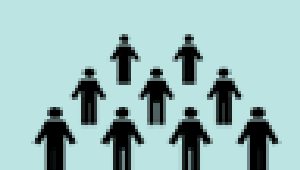
Population's knowledge about water resources and Biguglia lagoon

According to you, what is the main fresh water resource on the watershed?

- ☐ Surface water
- ☐ Precipitation
- ☐ Groundwater

What does the Biguglia lagoon represent for you?

- ☐ Environmental interest site
- ☐ Unhealthy and polluted site
- ☐ Economic interest site



Human activities

According to you, which water bodies are the most affected by degradations?

- ☐ Surface water
- ☐ Groundwater
- ☐ Lagoon
- ☐ None

- A total of **53 sampling points** including **21 pesticide samples** have been collected during the field campaign in spring 2021
 - **31** wells and boreholes owners have been interviewed
 - The field survey was led on **60%** of the sampled points
- The questionnaire is **still available online** for the local stakeholders

- The methodology is transposable at the **regional scale** to the others Corsican coastal hydrosystems

- Also, for **validation purposes**, this methodology will be used in other **Mediterranean regions** with different socio-economic and hydrogeological conditions, such as the **Le Cesine lagoon** in southern Italy (2022)



Validation
Mediterranean scale



Figure 3 : Excerpts from the questionnaire