The “HCH in EU project”: Part 3
The Valle del Sacco and Mulde river experience

Introduction

In the previous articles, we introduced the legacy of the former pesticide and anti-parasitic drug Lindane (γ-HCH) in Europe (part 1) and illustrated the context of Conceptual Site Models (CSM) and the environmental and health risks of HCH-contaminated sites (part 2). In this article, we provide background information on two pilot sites covered by the “HCH in EU” project to explain the challenges faced, the successes achieved and the importance of contaminated site management.

Valle del Sacco in Italy: context and history

The Valle del Sacco site is in Italy, in the industrial area of Colleferro near Rome. The site is included in the “Bacino del fiume Sacco” list of Remediation Sites of National Interest. This HCH-impacted site has a total area of 6,000 ha (Figure 1).

Within this area, Lindane was produced at the Bombrini-Parodi-Delfino facility (better known as the BPD Company), which was present from the post-war period up to the late 1970s. The facility left two uncontrolled industrial waste disposal areas with high concentrations of HCH isomers (α, β, γ). These dump sites are currently disused (Arpa-1 and Arpa-2).

Figure 1: Industrial area of Colleferro.

Figure 2 shows a photograph taken during the excavation of the HCH waste at the Arpa site in 2005. In the same year, high concentrations of β-HCH were detected in cow's milk from a farm in Gavignano, which led to tight controls. This resulted in the identification of 36 farms where β-HCH was detected in milk and dairy products.

Around this time, the Government declared a state of socio-economic and environmental emergency and the President of the Lazio Region was appointed as “Special Administrator” for the emergency, because monitoring of environmental matrices in Valle del Sacco highlighted an almost ubiquitous presence of

HCH isomers in soil, subsoil, groundwater and surface water.

Figure 2: "White substance" containing HCH isomers in the industrial area (2005, Public Authority of Colleferro).

Consultancy services and innovative techniques

The novelty of the "HCH in EU" project lies in the comprehensive and holistic approach to such a complex issue with very different scenarios at the local level. Six pilot projects were identified that gave a comprehensive overview of the issues, by assisting public authorities at local, regional, or national level confronted with sites affected by Lindane and HCH. The assistance involves providing expertise, advice and consultancy. The experience gained will be reported and all six reports made available to others confronted with the same challenges.

To support the sustainable management of the six sites contaminated with HCH, the following step-by-step approach is employed:

1. The start-up phase and assessment of what is required for the sustainable management of HCH-impacted sites.
2. The establishment of a Road Map to reach a sustainably managed site.
3. The implementation of the actions in the Road Map that match the scope and timeframe of the "HCH in EU" project (execution of the Action Plan).
4. A concluding workshop to share the lessons learned with stakeholders of other sites facing similar issues.

A preliminary gap analysis of the existing CSM carried out together with the Site Authority (Regione Lazio) identified that the study and characterisation of river sediments should be prioritised. This Italian site involves a wide range of stakeholders, including Public Authorities and private organisations. An essential first step towards bridging the gaps (updating) of the CSM was to collect the data available from the various actors and standardise these for the purpose of subsequent manipulation and study. The collected data are characterised by a very strong spatial and temporal heterogeneity and concerned:

- Ecological Risk Analysis made in Valle del Sacco
- Characterisation of environmental matrices (soils, groundwater) in the Colleferro Industrial Area from private organisations (2006-2020)
- Remediation projects in the Colleferro Industrial Area carried out by private organisations (2006-2020)
- Previous characterization of riparian/alluvial areas in the river valley
- Characterisation of flood plains and fluvial sediments (2006 and 2008)
- Water monitoring data from ARPA Lazio (since 2005)
- Previous characterisation of fluvial sediments (2006-2008)

The consultancy skills of DND Biotech and TAUW were employed to produce a holistic and thorough study of the huge site, which was previously unavailable. This was mostly due to the tendency to focus on specific issues rather than looking at the bigger picture. It also confirmed that even if the task is difficult, all the surveys carried out throughout the years represent valuable information that should not be disregarded. Lessons were learned that allowed the CSM to be updated to include a more complex model for the transport and diffusion of contaminants. QGIS was populated with the data and interpolations were made (Figure 3) to gain a better insight into the current situation, retrieve a great deal of useful information (such as the presence and distribution of HCH isomers) and help us develop a characterisation plan.

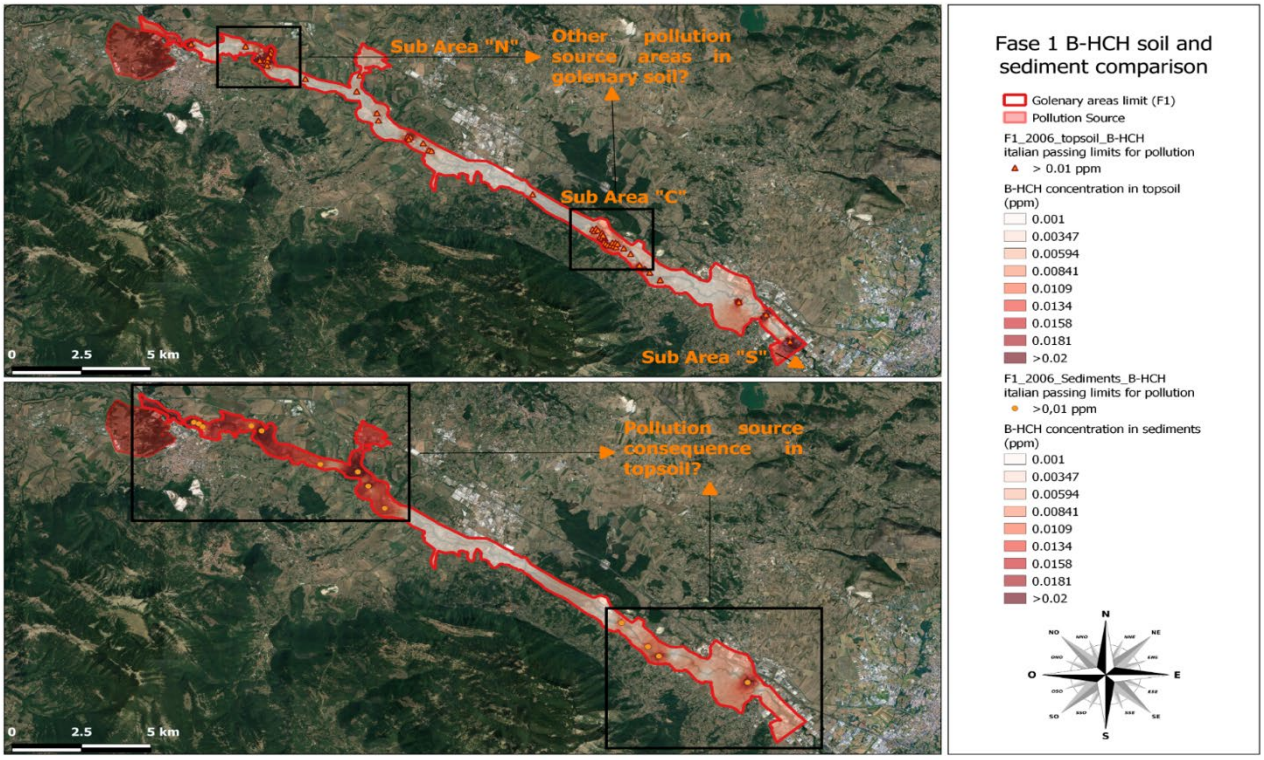

Figure 3: Example of QGIS output providing a picture of the concentration patterns and showing the concentration gradients.

We also considered the use of innovative inexpensive technologies for surveys of the priority areas such as:

- Unmanned aerial vehicle to build orthomosaic with landscape survey to show the real current situation.
- Unmanned surface vehicle to investigate the sediment in the Sacco river water by means of a hydrographic survey.
- Geophysical instruments to investigate secondary sources of pollution (e.g. electromagnetic metric survey, gamma spectrometer survey and tomography).

Mulde river in Germany: context and history

The Mulde and Saale rivers in the state of Saxony-Anhalt, Germany (Figure 4) are major tributaries of the Elbe river basin and have been affected by significant releases of HCH from intensive historical industrial activities in this area. The Mulde river, which has considerable HCH pollution due to emissions from Lindane production at the Bitterfeld-Wolfen industrial mega-site, is one of the pilot sites in the “HCH in EU” project, alongside the Italian Valle del Sacco site.

International collaboration and innovative techniques

In setting up the investigation strategy for the Mulde river site, the “HCH in EU” project benefits from the experience that TAUW has gathered during previous projects.

Figure 4: Site of the Mulde river research area.

In these large-scale projects, which aim to mitigate surface water pollution on a river basin scale, the objective is to develop efficient, tailor-made measures to deal with pollutants that have spread over large areas. A reliable balance model is crucial to identify the various sources of water pollution and quantify their destination and transport. Conventional methods of sampling and analysis quickly reach their (economic and technical) limits here. As such, one of the objectives of the project is to test alternative methods, such as geophysical techniques.

The competent environmental authority for these sites, the Landesanstalt für Altlastenfreistellung (LAF), has been among the first to acknowledge this and has facilitated the necessary comprehensive and overarching site surveys required to arrive at a final assessment. Exchanges with international partners have demonstrated that the relevance of the topic is not limited to Saxony-Anhalt or Valle del Sacco. Deriving strategies and standardised procedures is highly relevant to achieving the ambitious goals of the Water Framework Directive (WFD) across Europe.

Identifying the particularly heavily contaminated areas within both the river sediment and flood plains, and quantifying the respective pollutant inventories, are relevant both for the assessment of the potential direct risks and of the potential recontamination mechanisms. As conventional investigative strategies (sampling and laboratory analysis) are generally not applicable at this scale, alternative investigation techniques have been applied. These include:

- Gammaspectrometric field surveys (by MEDUSA Explorations) to indirectly determine the pollutant concentrations in the near-surface substrate (cover picture and Figure 5).
- Conventional surface water and suspended load monitoring under varying hydrographic conditions.
- Soil and erosion surveys.
- Hydrographic and geophysical surveys employing (single beam) echo sounders, sub-bottom profilers, ground penetrating radar etc.

Figure 5: Gammaspectrometric field survey (left) and soil layer identification using a handheld XRF (right).

The interplay of the results obtained in this way allowed a comprehensive understanding of the system to be developed. The MEDUSA technique uses a mobile field gamma spectrometer that was developed to indirectly determine the texture, grain size and chemical composition of the near-surface layers of soils or sediments. Using grid lines previously defined based on preliminary examinations, the mobile gamma spectrometer is used to scan the natural element-specific gamma radiation of the soil substrate.

The measured natural radiation in the soil originates from the primordial radionuclides potassium (40-K), uranium (238-U) and thorium (232-Th), as well as from very low caesium activity concentrations (137-Cs), which have been present since man-made fallout first entered the environment in the early 1960s.

Earlier studies have shown that specific minerals or soil types can be differentiated by their unique radionuclide compositions, i.e. their "radiometric fingerprint". In many cases, significant relationships were also found between one or more of the radionuclides (the proxy) and one of the structural or chemical properties, such as the contaminant concentration of the sample. This relationship has been successfully used to transform maps of the measured radionuclides into maps of sediment/soil texture and HCH contamination (Figure 6) and has also been successfully applied to other pesticides (e.g. DDT), dioxins and metals.

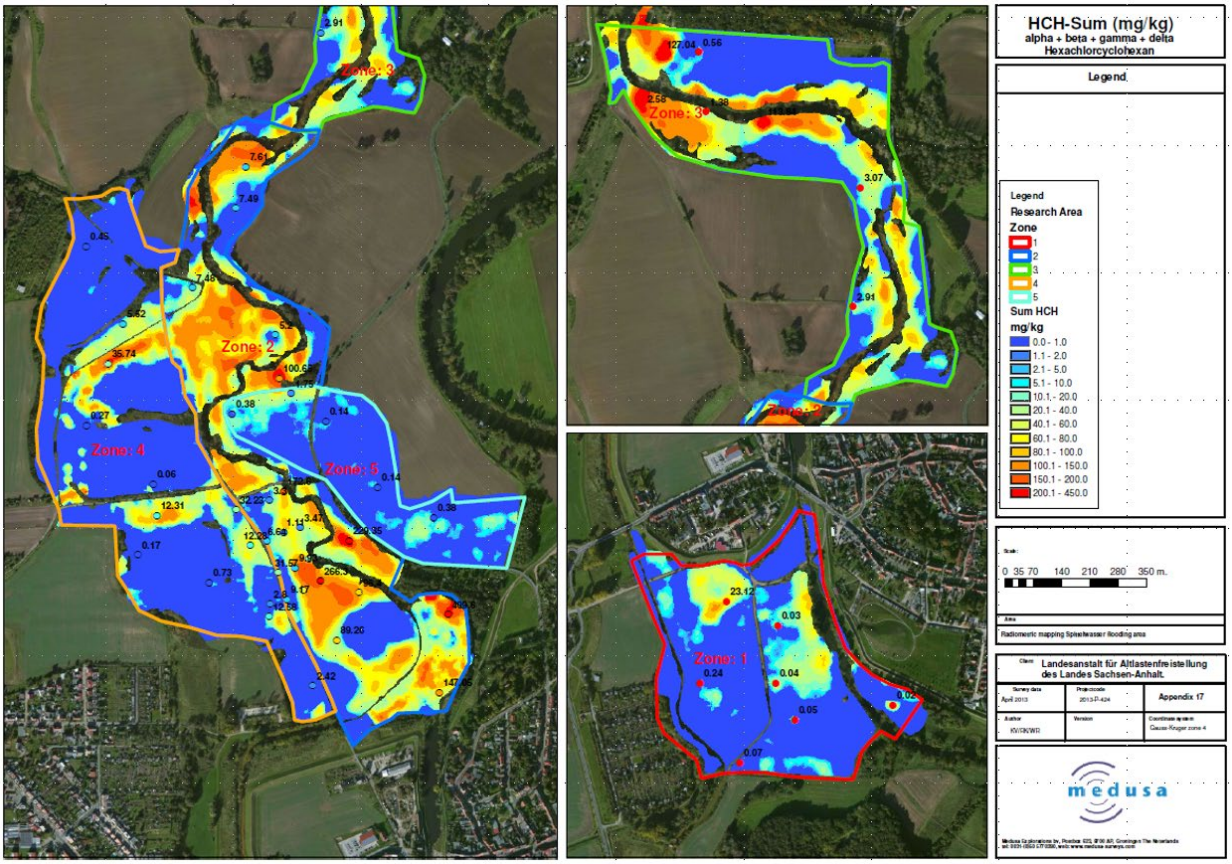

Figure 6: Mapped area from the gammasepectrometric field data used to calculate HCH concentrations within the Mulde river research area.

The "HCH in EU" project

The objectives of the "HCH in EU" project are to obtain a detailed picture of a number of sites potentially affected by HCH. These sites include former Lindane and HCH production sites, waste dumps, landfills and treatment centres in all EU member states. The project aims to help six different authorities that are dealing with the legacy of Lindane production. Identifying all possible HCH-contaminated sites and identifying the environmental and health risks is the first step towards gaining sustainable control of these HCH-contaminated sites.

More information about the project

For more information and the milestones of the "HCH in EU" project, please visit the project page on our website.