Solid Waste Landfill and Soil/Sediment Contamination: Case Studies in Tunisia, p.85-88.

Geographical Database for Soil/Sediment Contamination Survey in Tunisia

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Various kind of geographical and analytical data are accumulating in the environmental geochemical mapping project we are currently operating (Figure1; Yoshida and Kallali, 2002). We should consider the best way of organizing these data for optimal storage and access before considering in detail the ways in which spatial entities may be stored efficiently in the computer. In fact, creation of numeric geographic database, including all the pertinent information of soil quality and soil pollution, required to modeless the geographic area in order to put out all relevant entities which will be able to describe efficiently contamination type, their origins, their relationship with human activities (industrial, agricultural, existing waste landfill site,…), and the natural context (specially geology, elevation, slope ...). Thus, modeling of geographic space is an important action to organize and to structure all data in a geographic database. Spatial databases, however, contain many files with data on related aspects of the same entities, or of data on entities because their spatial proximity or connectivity has to be linked or grouped together.

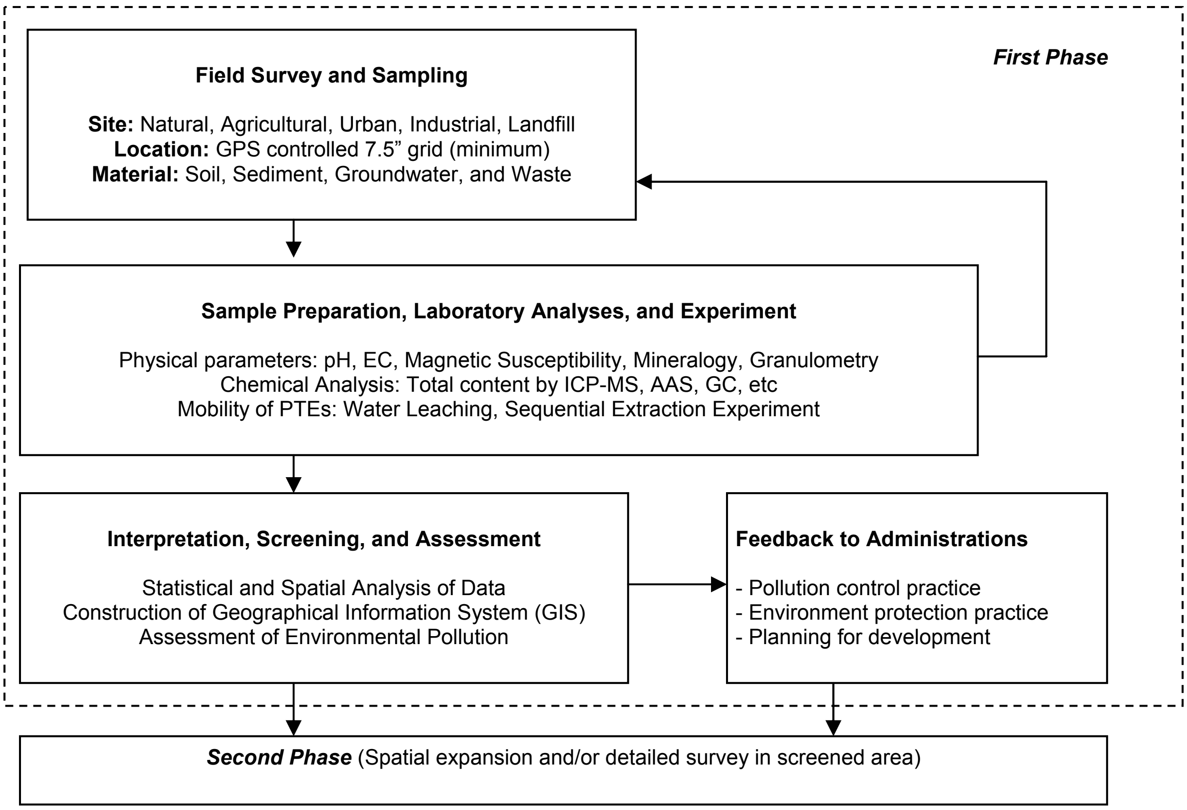

Figure 1: Schematic flow of the project (Yoshida and Kallali, 2002)

With the relational database structure, the data are stored in simple records, known as *tuples*, which are sets of fields containing an attribute; *tuples* are grouped together in two-dimensional tables, known as *relations*, where each table or *relation* is usually separated file.

The pointer structures in network structures and the keys in hierarchical structures are replaced by data redundancy in the form of identification codes that are used as unique keys to identify the records in each file.

Relational databases have the great advantage that their structure is very flexible and may meet the demands of all queries that can be formulated using of Boolean logic and mathematical operations. They allow different kinds of data to be searched, combined and compared. Addition or removal of data is also easy because this just involves adding a *tuple*, or even, a whole table. In addition, with an object-oriented database structure, each entity is defined in terms of data records and the attributes and their values.

Our project tends to do a diagnostic of soil/sediment contamination with many measurements and analyses on many sites (Table 1).

Table 1: Maximum size data set obtained from each site

Field data	Geographic information	Latitude and Longitude
		Altitude
		Name of place
	Land information	Land use (agriculture, urban, industrial, residential, others)
		Land nature (forest, dessert, salt lake, beach, plain, others)
	Soil/Sediment Type	Type (natural sediment, natural soil, agricultural soil, urban soil, waste-related soil/sediment, others)
	Field Description	Color, Grain-size, Consolidation, Smell, Others
	Magnetic Susceptibility	
	Others	
Lab data	Physio-chemical	pH, EC, CEC, TOC, Granulometry
	Chemical	- Potentially Toxic Elements (PTEs) using aqua regia extraction (37 elements) - Water extraction - Sodium acetate extraction - Sequential Extraction
	Mineralogical	- X-ray diffraction - Optical microscopy - Magnetic mineralogy

However, the success of such systems depends on the information availability and accessibility. In our case, chemical soil data results on really measurements in some sites with all necessary analysis. Establishing spatial analysis methods allowing to extrapolate some experiments from the fragment scale (or homogeneous unit) to the scale.

According to the rule of geographic database conception, the conceptual model must be the most independent of used technology and software. It must meet and correspond with need of different users and especially those responsible of soil use and pollution control. Modeling reality need to spot out all entities, their attributes, and all the relation, which can exist between different entities.

Choice of entities:

All entities are spot out by respecting criteria of relevance against of control of soil pollution and their origins, their relationships with human activities (industrial, agricultural, existing waste land full site,) and the natural context of each site.

Choice of attributes

Attributes of each entity are even selected by respecting criteria of relevance to describe entity, to be available and accessible.

Geographic Data Base

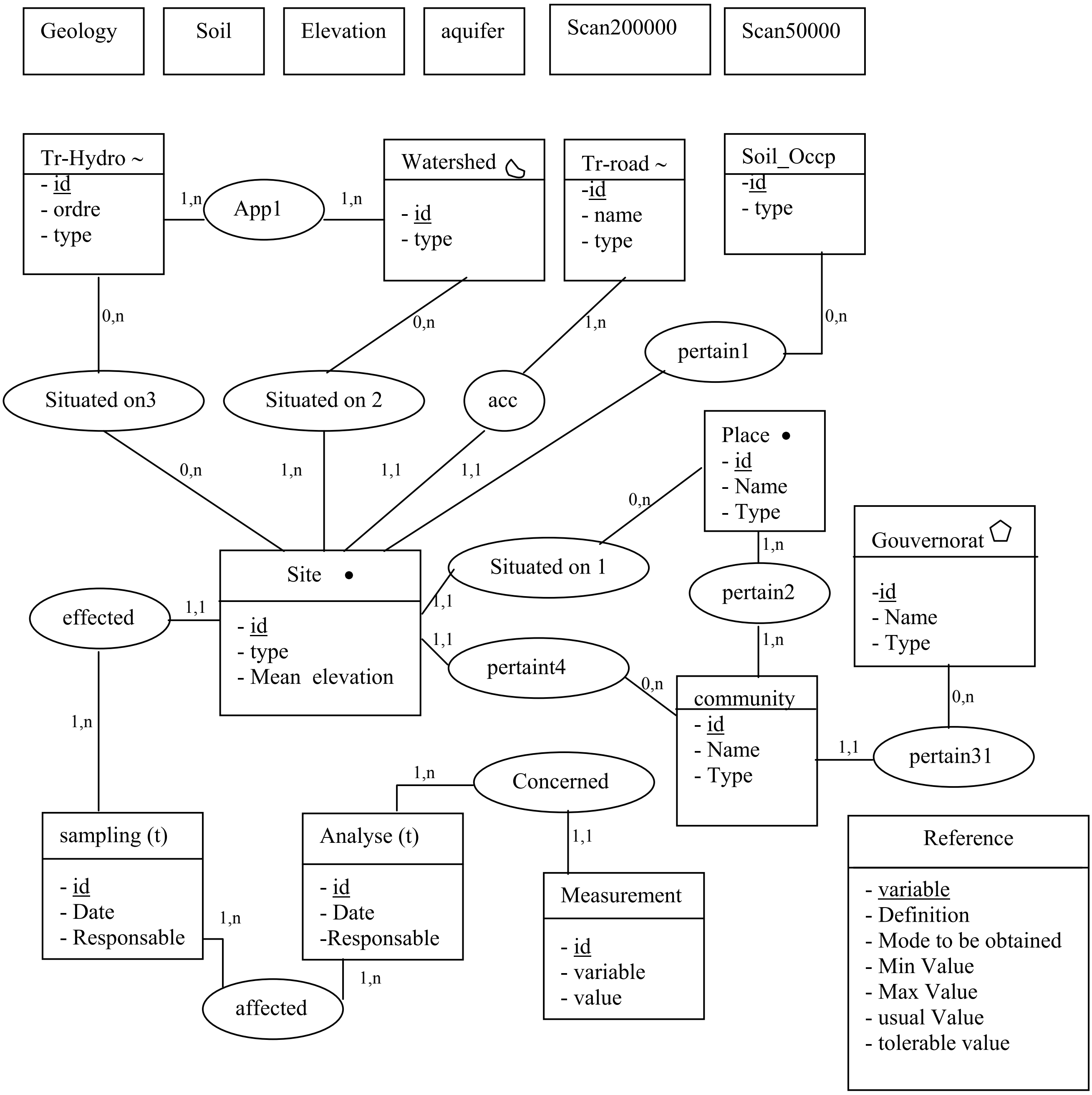

Figure 2: Data Conceptual Model (by Zohra Lili Chabaane /Genius Rural Engineering Water and Forests - INAT)

Choice of relation

Relations must describe and explain relationship between entities in order to understand and to explain soil contamination, its origins and its relationships with human activities (industrial, agricultural, existing solid waste landfill site).

On the basis of preliminary study on above-mentioned points, we propose a Data Conceptual Model shown in Figure 2.

Acknowledgements
We thank Ali M'hiri (INAT) and Ahmed Ghrabi (LEE-INRST) for their advice and encouragements.

References

Yoshida M. and Kallali, H., 2002, Soil contamination and natural background of potentially toxic elements (PTEs) in northeastern Tunisia: A screening project for environmental pollution. *Proceedings of International Symposium on Environmental Pollution Control and Waste Management (EPCOWM'2002),* 69.