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# SOIL QUALITY ASSESSMENT FOR SPATIAL PLANNING IN URBAN AND PERI-URBAN AREAS (southern France)

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## Facts

- Soils are considered as a major constituent of anthroposystems.
- In 2011, artificialisation reached 9% of the European territory with an increase of urban sprawl of 3% per year, larger than population increase.
- In France, the SRU law (solidarity and urban renewing law, 13<sup>th</sup> December 2000), and more recently the "Grenelle 2" law, have pointed out the need to control urban sprawl and support reconversion and densification aiming at preserving **soil quantity** (surface).
- There is no consistent either European or French legislations regarding soils management and conservation and no associated definition of **soil quality**.
- Soils fulfill many essential **functions** directly or only indirectly useful for societies such as support for agriculture, filtering of water or biodiversity tank. These functions deserve a better integration into land planning and land management procedures.

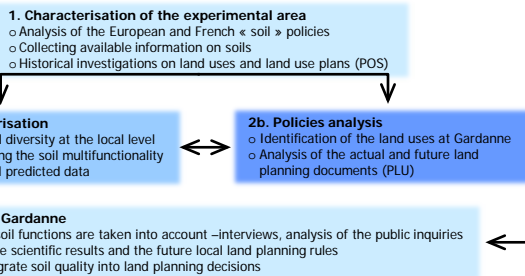
## Aim

To propose a methodology to integrate soil functions into land planning and land management procedures at a local scale, and apply it to the municipality of Gardanne (southern France).



An overview of Gardanne territory

## General procedure



## 2a. Soil quality index ?

Analysis of the PLU lead to the development of a **soil suitability index related to land use** including:

- 9 different land uses (forest and semi-natural areas, agricultural areas, wetlands, urban areas/artificial surfaces).
- For each land use, a given soil unit is able to perform up to 6 different functions: water flow and retention, retention and cycling of nutrients, physical stability and support, maintenance of biodiversity and habitat, buffering and filtering of potentially toxic materials and natural soil heritage. The sum of these functions represents the **"multifunctionality"** of the soil (Figure 2).
- For a given soil unit the sum of the satisfied functions is made first for its actual land use and then the same calculation is performed for the other land uses. The sum of results for the 9 land uses gives **the land use polyvalence Index** which can be spatialised.

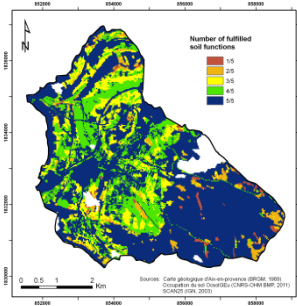
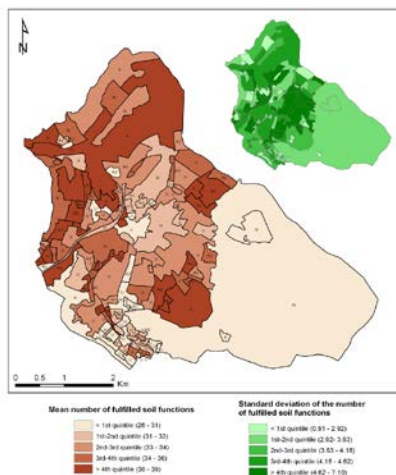


Figure 2: Soil / land use suitability index - actual use

Unit: Local urban planning (PLU) polygones

N = natural area  
A = agricultural area  
U = urban area  
AU = planned as an urban area

## 3. Originality of the approach



Mean number of fulfilled soil functions

< 1st quartile (25 - 31)
1st-2nd quartile (32 - 37)
2nd-3rd quartile (38 - 34)
3rd-4th quartile (35 - 36)
> 4th quartile (38 - 39)

Standard deviation of the number of fulfilled soil functions

< 1st quartile (0.97 - 2.02)
1st-2nd quartile (2.03 - 3.03)
2nd-3rd quartile (3.03 - 4.18)
3rd-4th quartile (4.19 - 4.82)
> 4th quartile (4.82 - 7.10)

## 1. Diagnosis of the territory

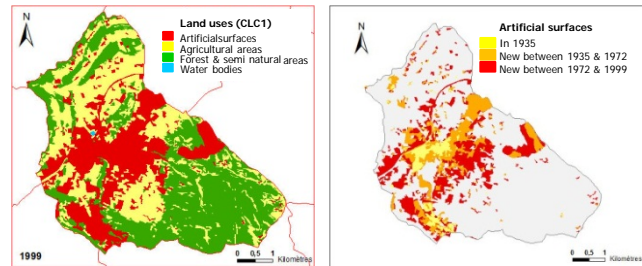


Figure 1: Land use changes between 1935 and 1999 - Corine Land Cover level 1

- The artificialised areas (CLC class 1) represent 3.5% of the total area in 1935 while they reach 26.8 in 1999.
- Initial agricultural areas have been consumed, mostly as the consequence of urban sprawl from the existing built-up areas.

## 2b. Local urban planning analysis

- Various alternatives have been identified to integrate information on soils into the local urban planning (PLU) documents. This could be done :
  - in the compulsory environmental evaluation
  - in the introducing report of the local plan (not binding)
  - in the PADD (sustainable urban and development plan) (not binding)
  - in the specific development recommendations (binding)
  - in the binding rules of each zone of the PLU (binding for each zone)
  - in some reserved areas for specific activities (binding)
  - in the protected woods or protected agricultural zones (binding)
  - in the rules for risk management: hazard maps, natural risks plans (binding)

Figure 3: Land use polyvalence index mapping according to the PLU polygones

Analysis of the map indicates that:

- Assuming that natural and agricultural areas are the most demanding uses in terms of functions, some PLU areas are not matching the results of the index, indicating the limited knowledge on and/or interest in and/or weight of soil quality while building the PLU
- There is variability in soil index accuracy mostly due to limited access to the soil (private property) and an increasing soil history complexity in the urban areas

## Conclusions

- This experimental approach aimed at sensibilising local authorities 1) to soil functions or soil quality and its potential degradation, 2) to the advantages they could draw from a sustainable soil and land management. Feedback from the Gardanne local authorities indicate an interest in using such a tool while amending their PLU.
- The experiment highlights the need for a pluridisciplinary approach in order to propose a meaningful evaluation of soil quality of land planners.
- It allowed for a complete analysis of the French and European laws highlighting the specific status of soil as compared to air and water.