Soil information for supporting new redevelopment and rural development processes in industrial areas: a case study in Sardinia (Italy)

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Introduction

Industrial settlements may reduce agricultural land, causing its complete abandonment and compromising the quality of soils and the possibility of recovering the ancient agricultural vocation. This is the case in two industrial areas of southern Sardinia (Italy) (Fig. 1), where heavy chemistry plans were settled in 1960's in former agricultural land. The aim of the present study is to provide soil information to local authorities to identify and evaluate the extent of the phenomenon and for supporting new redevelopment and rural development processes.

Figure 1. Location of study areas: Portovesme (red) and Macchiareddu-Sarroch (light blue).

Materials and methods

A GIS approach was used. Air photo interpretation with field checks allowed the analysis of the transformations of the agricultural landscape due to industrial activities. The following areas were identified: traditional areas (areas where agricultural use continues), abandoned areas (areas where agricultural use has been abandoned) and consumed areas (urbanized areas and industrial infrastructures no longer classifiable as rural areas). Existing and new soil data were collected to produce a Land Unit and Land Capability Map, 1:50,000 scale. Most of the map units represent soil consociations, while soil associations and complexes characterize few map units. Soil data were also used to assess five ecosystem services according to the method proposed by Calzolari *et al.* (2016): habitat for soil organisms (BIO), soil purification capacity (BUF), potential carbon sequestration (CST), potential food provision (PRO) and potential water regulation-water storage (WAS). A single value for each ecosystem service was attributed to each map unit.

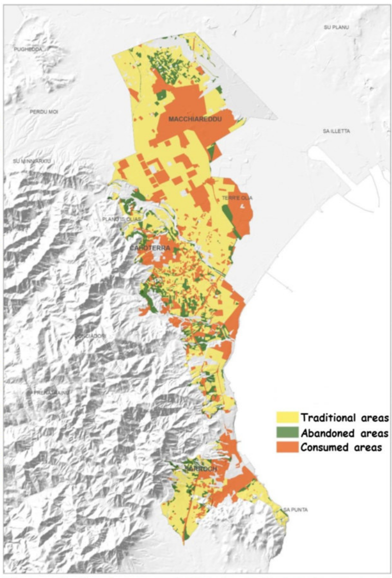


Figure 3. Land use evolution in agricultural areas of Macchiareddu-Sarroch from 1954 to 2019.

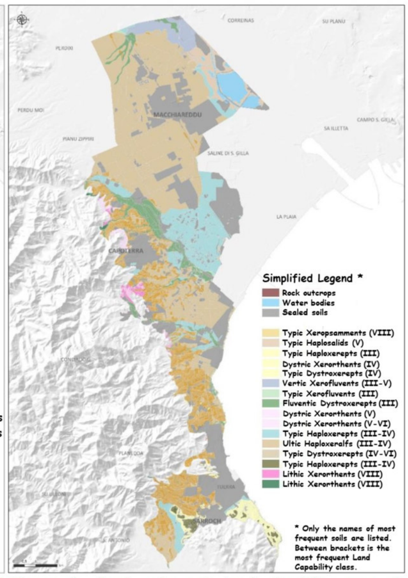


Figure 4. Land unit and Land Capabiliy map of Macchiareddu-Sarroch.

Results and Conclusions

In the Portovesme area, from 1968 to 2019, the agricultural land decreased by 788.4 ha, natural and seminatural land lost 8.4 ha and urban and industrial areas expanded on 796.8 ha. Most of the agricultural land lost due to industrial expansion was cultivated with vineyards (491.8 ha). Traditional, abandoned and consumed areas (Fig. 2) account for 50%, 22% and 28%, respectively, of the pre-industrial agricultural land.

In the Macchiareddu-Sarroch area, from 1954 to 2019, the agricultural land decreased by 3,195.4 ha, while natural and seminatural land and urban and industrial areas expanded by 536.6 and 3,283.7 ha, respectively. Traditional, abandoned and consumed areas (Fig. 3) account for 55%, 11% and 34%, respectively, of the pre-industrial agricultural land.

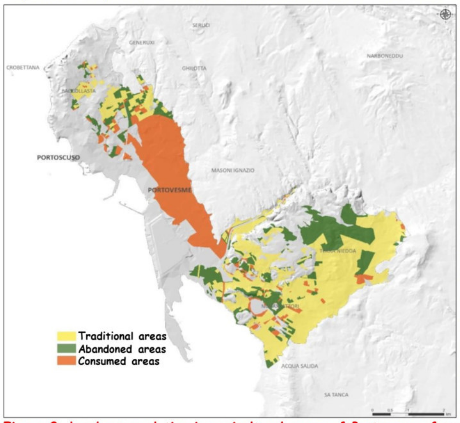


Figure 2. Land use evolution in agricultural areas of Portovesme from 1968 to 2019.

In the Macchiareddu-Sarroch area, the most widespread soils (Fig. 4) are Ultic Haploxeralfs (on Pleistocene alluvial deposits) (4,480 ha) and Typic Haploxerepts (mostly on Holocene alluvial and colluvial deposits) (1,221 ha).

In the Portovesme area, the most widespread soils (Fig. 5) are Dystric Xeropsamments (on Holocene sands) (1,008 ha), Lithic Xerorthents (on Miocene ignimbrites) (542 ha) and Ultic Haploxeralfs (on Pleistocene alluvial deposits) (517 ha).

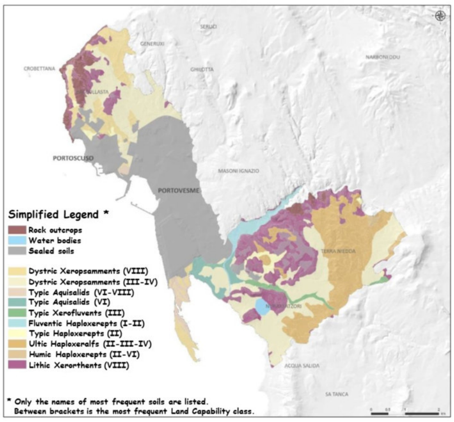
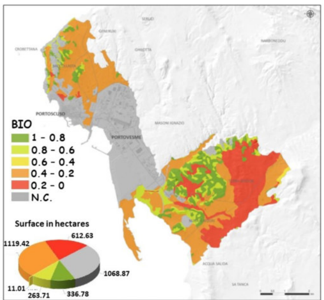


Figure 5. Land unit and Land Capabiliy map of Portovesme.

The full legend of the Land Unit and Land Capability maps reports, for each land unit, the following information: lithological substrate and soil parent material, morphology and physiography, land use and prevalent vegetation cover, main morphological characters and chemical-physical properties of soils, Soil Taxonomy classification at Subgroup level, WRB classification at second level, Land Capability classification at subclass level, main constraints, and guidelines for soil protection and conservation.

In the Portovesme area (Fig. 6) the BIO, BUF, CST and WAS ecosystem services are mostly provided by soils that fall into the 0.2-0.4 class (32.8%, 23.8%, 25,4% and 23.8% of the area, respectively). The soils of the lowest class (0-0.2) and those of the highest class (0.8-1) respectively cover 17.95% and 9.87% of the area for BIO, 9.86% and 0.32% for BUF, 16.74% and 1.72% for CST and 22.74% and 20.58% for WAS. For the PRO ecosystem service, the most represented class belongs to the values 0.4-0.6 (III-IV class of Land Capability) and covers 38.99% of the area. The best soils (I-II class of Land Capability) and the worst ones (VI-VIII class of Land Capability) cover 1.74% and 26.3% of the area, respectively.



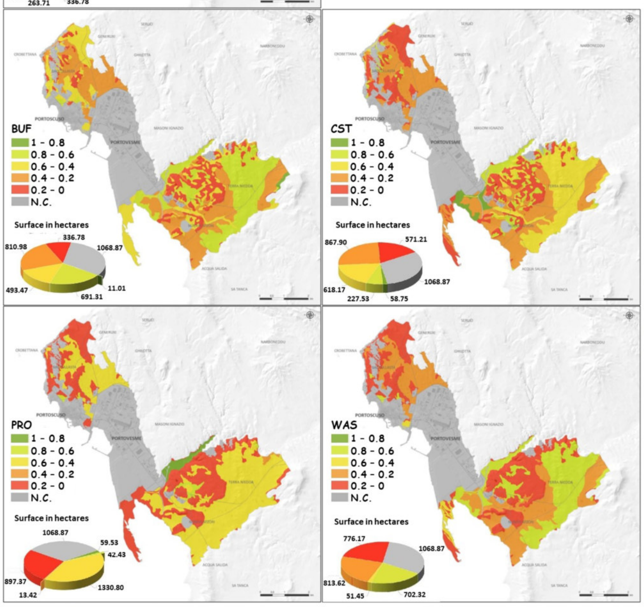
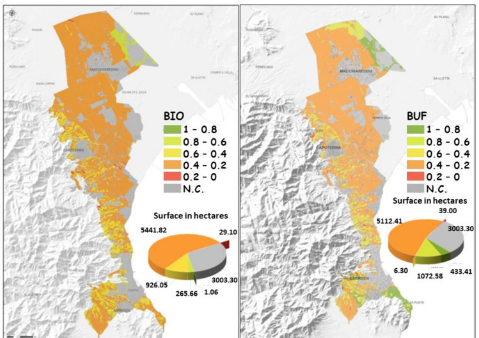


Figure 6. Distribution of soil ecosystem services in the area of Portovesme.

In the Macchiareddu-Sarroch area, the BIO, BUF and CST ecosystem services are mostly provided by soils that fall into the 0.2-0.4 class (56.3%, 52.9% and 60.25% of the area, respectively). The soils of the lowest class (0-0.2) and those of the highest class (0.8-1) respectively cover 0.3% and 0.01% of the area for BIO, 0.05% and 4.5% for BUF and 4.2% and 0.08% for CST. For the PRO ecosystem service, the most represented class belongs to the values 0.4-0.6 (III-IV class of Land Capability) and covers 56.5% of the area. The best soils (III-II class of Land Capability) and the worst ones (VI-VIII class of Land Capability) cover 0.43% and 26.3% of the area, respectively. For the WAS ecosystem service, the most represented class belongs to the values 0.4-0.6 (46.6% of the area). The soils of the lowest class (0-0.2) and those of the highest class (0.8-1) respectively cover 2.7% and 2.5% of the area.



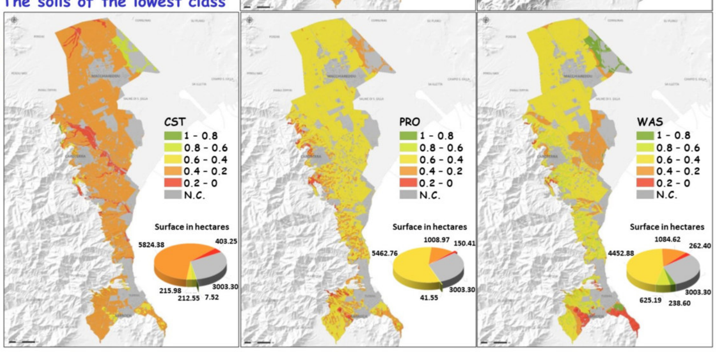


Figure 7. Distribution of soil ecosystem services in the area of Macchiareddu-Sarroch.

References

Calzolari C., Ungaro F., Filippi N., Guermandi M., Malucelli F., Marchi N., Staffilani F., Tarocco P. (2016). A methodological framework to assess the multiple contributions of soils to ecosystem services delivery at regional scale. *Geoderma* 261, 190-203.