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An extra-urban soil cadastre for Italy: a first guide for the introduction of soil information

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Abstract
Assuming a positive outcome of the parliamentary procedure for laws and, thus, the transformation of the official cadastre for buildings and land into a soil cadastre (urban, extra-urban and cadastre for the conservation of natural or semi-natural soil diversity) would start a new era for pedology. Finally, after many decades of activity to expand soil culture in Italy, almost all Italian families would be in contact with a soil specialist. Land use and redefined plots would be handled with greater care and responsibility. Experts in agricultural and forestry and biodiversity conservation would have a new impetus in their activity. Furthermore, economists will also have to address new issues. The aim of this work was to analyse how to meet the needs of a future Cadastre with respect to soil information both from a descriptive (Cadastral Certificate) and a cartographic point of view and to outline a practical guideline for future technicians who will be in charge of maintaining and updating the soil information system. To this end, we used the area of Caccamo (Sicily) and its soilscape as an example to put this concept into practice. On the one hand, this contribution aims at stimulating the start of a scientific-technical debate and, on the other hand, to give practical indications for the solution of the problem.

Keywords
Soil cadastre, Soil information, Reference soils, Sustainability

Introduction

In several countries (e.g., Germany, Austria), the functions of soils are legally relevant and are the basis for sustainable development (Bundes-Bodenschutzgesetz, 1998; ÖNORM, 2013). Soil maps are normally the basis for the necessary data. In Europe, the calculation procedure and legal impact differ, however, from country to country. In part, also economic values have been attributed to soils. The soil functions can be understood in this respect as ecosystem service. The basic concept behind this view is that the soil delivers services in a direct or indirect form (Costanza et al., 1997; Schröter-Schlaack, 2017). This concept has initiated an intense debate. The concept of ecosystem services enables to demonstrate the variety and significance of the natural livelihood for human beings. One usually distinguishes between ecosystem processes, functions and services for humans (Haines-Young and Potschin, 2010). The Millennium Ecosystem Assessment (MEA, 2005) was commissioned by the United Nations to capture the state of the ecosystems and change of ecosystems on human welfare. In this context, the soil plays a crucial role among the following categories of ecosystem services: production function (agricultural products, water, wood) and regulation function (climate, erosion, hydrologic balance etc.). To make the services of the soils visible, the G8-states initiated together with the European Commission a study on the economics of ecosystem and biodiversity (TEEB, 2010). To underpin the value of soils in the context of sustainable development, new political instruments that define management standards and set price signals are urged. Among these instruments is the soil cadastre.
The aim of the establishment of a soil cadastre is to ensure that land use becomes sustainable. For this reason, the

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use must be assessed in relation to sustainability, fiscal aspects and environmental risk preventions (Raimondi, 2017). The new structure of the Italian cadastre will have three sections: the urban soil cadastre (Raimondi, 2018a), the extra-urban soil cadastre or land cadastre (Raimondi, 2017) and the cadastre for the conservation of soil-biodiversity or natural to semi-natural pedodiversity (Raimondi, 2018b). The urban soil cadastre will deal with both the built-up area and urban greens for sustainable management. A management can be defined sustainable when a green area whose natural or artificial development (as a consequence of green operations, e.g. pruning) produces wealth and/or does not cause any damage to people, animals, plants and movable and immovable objects. For this purpose the sustainable urban green management integrates the information on cadastral map and certificate, by including everything that is above and below (e.g. electricity lines, communication networks, pipes of drinkable water, drainage water and sewage sludge) the ground surface, and the parts of hydrographical network (i.e. lakes, narrow valleys, streams and rivers) (Raimondi, 2018a).

Under such conditions, it will be necessary to create an office having specialists in pedology. The Italian law must initiate the transfer of pedological information that is present in various ministries and regional departments to the "information node" of the soil cadastre. The association of agronomists and forestry scientist constitutes the most valued professionals in this new professional specialisation of Italy. In this context, the universities should collaborate with these associations and organise professional qualification courses. The pedologists who manage today the pedological information system clearly point to the enormous workload to be done. The soil cadastre has a very detailed information structure and therefore presents many practical difficulties in the data transfer phase (scale 1:2000 and 1:4000). Field pedologist and interdisciplinary teamwork will have an eminent importance in fulfilling these tasks. The proposed new law has been submitted to the legislation process. Now the opinion of the scientific world, the professional associations together with the agricultural business partners is expected. The hope is that the parliamentary process will approve it during this legislature which is in the interest of all Italians (and also in the interest of all EU countries). Pedologists must be united, and have to present themselves to the outside world with great professionalism. At the moment there are many AGR (Agricultural and Veterinary Sciences – one part among the academic disciplines for Italian universities, research and teaching) sectors of the University of Palermo that share this initiative. Among these are AGR 14 (Pedology), AGR13 (Agricultural chemistry), AGR 02 (Agronomy and field crops) and AGR 01 (Agricultural economics and rural appraisal). Also in Sicily, almost all professional associations dealing with territory and environment are available to collaborate and play their part (geologists, engineers, architects, agrotechnicians and surveyors).

General procedure of soil data integration into the soil cadastre

With this work we want to develop a practical guide that can be useful during the editing phase of the law. The technicians will be defined who will be responsible for the pedological information and/or related update. This concerns the plots of the extra-urban and urban soil cadastre (for territorial uniformity: the soil mass and related altitudinal zone). The soil cadastre derives from a review of the land cadastre and differs from the latter by a wider and more detailed description of the plot. Environmental and territorial data have been included in the cadastral certificate with the aim of achieving widespread sustainable use, so as not to degrade the soil and other environmental resources (air, water, plant and animal biodiversity, landscapes of archaeological, historical or architectural importance). Soil is a contemporary patrimony that has been inherited from previous generations and must be preserved for future generations for food production (soil sustainability) and ecosystem services. The environmental aspects (such as climate and geology) are described in the fourth section of the table of the soil cadastre (Table 1). Later, the taxonomic family (soils) according to the Soil Taxonomy will be introduced. The certificate requires the inclusion of additional soil relevant data such as: altitudinal zone, average slope angle, aspect, rock content, drainage and thickness of the solum. Similar to the land cadastre, benchmarks are present that are useful for many cadastral activities such as the pedological information (description and georeference). Currently the Italian pedological database is managed by the CRA-ABP (Centro per l'Agrobiologia e la Pedologia of Florence) that holds the soil information of Italy collected over several decades (http://sito.entecra.it/portale/cra_dati_istituto.php?id=204). The CRA-ABP has developed a pedo-databank (basing on a survey having a scale of

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1:100000), the Italian Soil Information System (ISIS). This databank bases on the project "Badasuoli".

Logo of Territorial Agency	Soil Cadastre Request data		Municipality of Corleon (Code: xxx) Province of PALERMO
	Name and Surname _____ Street _____ City _____ZIP Code_____ Tax Code _____ 1st Acess	Sheet: 200 Parcel: 22 Entry: 12 2nd Access	Cartographic data Official Italian Cartography: F. (Sheet) 258II NO Corleone (scale 1:25,000) Regional Technical Map:_____(scale 1:10,000) Detailed Cartography: _____ (scale 1:5,000 or higher)

N.	PERSONAL DATA	TAX CODE	ACTUAL RIGHTS & DUTIES
1.	Pinco Pallo born in Corone, 22/02/1991 resident in Palermo, Fresca, 32	_____	Ownership 1/1 in community of property
2.			
DATA RESULTING FROM	Instrument (PUBLIC DEED) of the 21/03/1995 Transfer of registration n. 2500 1/1995 in deeds from 10/08/1996 (redord n. 300132) Collection n. 52893 Authority representative: CELESTE Aida. Office: PALERMO DIVISION		
MANAGEMENT *(1)*	By owner (or tenant) 3rd ACCESS		

Identification data						Resulting data	Production sector	Agriculture type
Sheet	Parcel	Subparcel	Part	Central point Coordinates *(2)*	District	Splitting up	*(3)*	*(4)*
15	55	———	——	4th ACCESS	Cangialosi	———————	Vie del Formaggio dei Monti Sicami	Biological

Eviromental data									
Climate (Thorntwaite) *(5)*	Lithology *(6)*	Soil Taxonomic Family *(7)*	Altitudinal range (m a.s.l.) *(8)*	Mean slope (%) *(9)*	Predominant aspect *(10)*	Rockiness (R) Stoniness (S) *(11)*	External drainage *(12)*	Position of temporary hydrographical network *(13)*	Solum thickness (cm) *(14)*
C_2B_1'sb$_3$'	Limestone	Entisol: T U, f,m, m	Min 1035 Max 1112	20	North	R = 10% S = 40%	Excessive	Missing	40

Territorial data					
Mountain *(15)*	Constraints *(16)*	Acces roads from the town of Corleone National B1, provincial B2, municipal B3 *(17)*	Water availability *(18)*	Pollution *(19)*	Unit of Use Capacity (Land Capability Classification) *(20)*
Mountain	A1, A2, A3	B1 = SS 118; B3 Imbriaca Barracù	No	No	VIIe5

Rating data								
Intended use (Quality) *(21)*	Specifications of agricultural use: crop and class or other *(22)*	Physical sustainability of specific use *(23)*	Requirements (C) *(24)*	Area m² ha are ca *(25)*	Income: Real estate	Income: Agricultural	Tax deduction (D) € *(27)*	Tax Addition (E) € *(28)*
					Annual financial statement € *(26)*			
Grazing	Pasture 2	Sustainable	C1	1 36 97	100	20	D3 30	- -

Table 1. *Example of a new soil cadastral certificate. See Raimondi (2017) for the denotation of the red numbers.*

This is a computer infrastructure (e-Infrastructure) where all researchers can find data in their databases, but also in the databases of other researchers. The researcher will simply have to make the registration through which the authentication key for access will be provided. The data concerns metadata, text documents, maps, sensors, statistical data and GIS. In particular ISIS contains the "soil regions" and the first level of soil information, in order to correlate the soils of Italy with the "soil systems" of other European countries and for the correlation, at a national level, with STUs (Soil typological units) and with soil sub-systems at regional level. The present database is nothing more than an inventory of the Italian soil landscapes at two scales: 1:5.000.000 for the soil region and 1:500.000 for the soil systems. The Centro Nazionale di Cartografia Pedologica (CNCP) was created by the CRA-ABP within the project "Metodologie pedologiche: definizione di criteri e specifiche per la realizzazione, conservazione, aggiornamento e consultazione della carta dei suoli d'Italia in scala 1:250.000" and deals with soil research at the national level, cartographic procedures through the use of GIS, management of the soil database of Italy and collects information on soil maps.

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A major step forward has been the numerical classifications of soils. Today, the AQP (Alghoritm for Quantitative Pedology) application is used, an open source R software library, which contains various functions such as: vertical and horizontal graphic representation of soils, management of experimental XRD (X-ray Diffraction) diffraction patterns and profile comparison. The methodology bases on a search of the database using multiparametric queries or through filters. The taxonomic classification is the main discriminant for the creation of groups. The CRA-ABP used the functions of the AQP for the revision of the Badasuoli database and for the "Agroscenari" project to identify climosequences (monitoring of soils with the same evolutionary starting conditions, but located in different climate).

Today, in Sicily, the pedological information consists of a map having a scale of 1:250,000, while the geological information is mostly available at a scale of 1:50,000 and, therefore, much more detailed. The last soil cartographic update of the Region of Sicily was again carried out at a medium scale (1:250,000), despite the fact that two of them already existed. Fierotti and Raimondi (2004) claimed that a more detailed regional soil mapping was needed, i.e. at a scale of 1:50,000, so that soil information could be operated and managed in an easier and better way (with more detail and better possibilities to address the sustainability of land use).

The soil cadastre should periodically acquire new data from the CRA-ABP into its database. Each parcel will have its own pedological information that will need to be checked (a first hint gives the soil map of 1:250000). A freelance technician, appointed by the land owner, will have to do a soil survey at a scale of 1:1000 to 1:4000 by using satellite images, describing soil profiles and performing mapping.

A practical example of data collection and integration into the soil cadastre

A pedologist will be confronted with two different cases when collecting data (Table 2).

Cases	Conditions	Actions
1st case		Profile is similar to reference profile ➔ existing classification is extended to new parcel ➔ definitive entry
2nd case		New profile is different to closets reference profile Documents to be submitted
	≤ 0.5 ha	- Field plan with profiles - Photo of the site and profile photo - Soil (field) classification - Indications about soil degradation
	> 0.5 ha	- Field plan with profiles - Photo of the site and profile photo - Chemical data of soil (sub) horizons - Soil classification based on analytical characteristics - Detailed evaluation of soil degradation (land capability)
3rd case	independent of the size of the area	Change in land use planned Documents to be submitted - Field plan with profiles - Photo of the site and profile photo - Chemical data of soil (sub)horizons - Soil classification based on analytical characteristics - Detailed evaluation of soil degradation (land capability)

Table 2. *Cases encountered when characterising a parcel.*

The first case is the one in which the soil, located in the parcel of interest, has the same characteristics as the reference profile and, therefore, the soil type is already studied. The soil information is sufficient and the entry into the databank becomes definitive. The reference profiles have the following documents: description

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of the pits and surrounding, description of the soil horizons down to the parent material with analytical data. At least two photos, one of the site and one of the profile must be provided together with a detailed map of the site. The satellite image AGEA (Agenzia per le Erogazioni in Agricoltura) may be used that is publicly accessible. There may be several profiles of the same soil family in the same area. A practical example are the soils along the hills of Caccamo, in the Scorusa district (Sicily) where the soils of the Scorusa series (Gypsic Xerochrepts) have been described and analysed (Table 3).

Therefore, if the soil in the plot of interest is close, for example, to the Type A reference profile (Scorusa Series; Figure 2), whose description and analytical data are available, the technician should simply write the taxonomic family in bold (for the description of the taxonomic family see Raimondi et al., 2000). The profile sheets will have a shape similar to that shown in Table 4. The recommended data to be recorded for a reference profile are given in Figure 2.

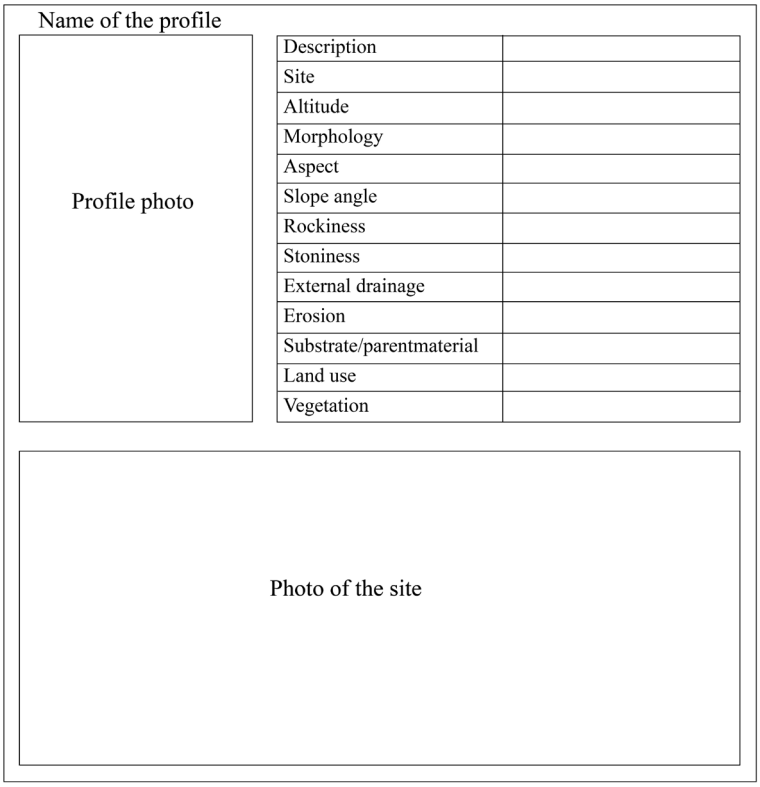

Figure 1. *Recommended basic data and information for the reference profile*

The second case is the one in which the soil has different characteristics and qualities compared to the available reference profiles and, therefore, requires a soil study in order to characterise and classify the soil. The activity to be carried out depends on the extension of the surface of the parcel. There are two possible (important) sub-cases: the first concerns parcels having an area ≤ 0.5 ha; while the second concerns parcels having an area > 0.5 ha.

In the first sub-case, if no change in land use is planned, no analytical studies are urged. Therefore, a series of profile drillings will be sufficient to identify and characterise the soils. When having a sufficient background, even the owner can perform the complete soil survey work by opening the profile and classifying the soil. The documentation, that has to be communicated to the Cadastre, consists of the description of the site, the description of the soil profile and horizons and related photos. Obviously, the technician will have to ascertain, through a certain number of drillings, whether or not the soils are the same. If the parcel has a soil series consisting of two taxonomic families, the parcel will be divided into two. If, the surface exceeds 0.5 ha, then it will be necessary to open a reference profile and perform a complete pedological study: description of the site and profile, taking photos and performing the required analyses of the horizons and sub-horizons.

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Profiles		Guzzo (site 200. Fig. 2)		Scorusa (site 1. Fig. 2)		Scorusa. rocky (site 134. Fig. 2)	
Horizon		Ap1	Ap2	Apy1	Apy2	Apy1	Apy2
Depth	(cm)	0 - 20	20-40	0 - 20	20-40	0 - 20	20-40
Clay	(%)	52.2	50.2	53.8	51.6	48.3	55.6
Silt	(%)	17.2	18.3	22.0	21.2	20.0	21.5
Sand	(%)	30.6	31.5	24.2	27.2	31.7	27.9
Skeleton (estimated)	(%)	–	–	–	–	30	30
pF 2.5 (estimated)	(%)	30.2	30.9	25.7	25.0	24.5	25.4
pF 4.2 (estimated)	(%)	17.3	18.0	13.1	12.6	12.3	12.9
AWC*(estimated)	(mm/cm)	1.4	1.4	1.4	1.4	1.0	1.0
pH 1:2.5 H_2O		8.1	8.1	7.7	7.5	7.6	7.6
pH 1:2.5 KCl		7.4	7.4	7.3	7.3	7.3	7.3
$CaCO_3$	(g/kg)	75	71	160	150	155	150
C organic	(g/kg)	11	12	12	12	12	12
Nitrogen	(g/kg)	1.2	1.2	1.5	1.4	1.3	1.3
C/N		9	10	8	9	9	9
Organic substance	(g/kg)	19	21	21	21	21	21
Assimilable phosphorus	(g/kg)	0.020	0.020	0.016	0.018	0.018	0.018
EC	(mS/cm)	0.13	0.13	1.61	1.80	1.60	1.65
Na^+ sol.	(cmol(+)/kg)	0.04	0.04	0.09	0.10	0.10	0.10
K^+ sol.	(cmol(+)/kg)	0.09	0.06	0.18	0.22	0.19	0.19
Ca^{++} sol.	(cmol(+)/kg)	0.85	0.80	14.80	16.20	15.00	14.60
Mg^{++} sol.	(cmol(+)/kg)	0.35	0.30	0.40	0.38	0.44	0.40
NaCl	(g/kg)	0.10	0.15	0.32	0.30	0.30	0.30
Chalk (Vieillefon)	(%)	–	–	19.42	25.00	22.60	24.40
C.S.C.	(cmol(+)/kg)	28.8	30.2	8.5	8.0	9.0	9.5
Agronomic potential index	(%)		58		40		44

Table 3. *Analytical data of the investigated profiles in Caccamo (Raimondi et al., 2000)*

Horizon	Clay	Silt	Sand	pF		A.W.C	pH 1:2.5		$CaCO_3$	
						cummul.			total	active
(cm)		g kg^{-1}		2.5	4.2	mm	H_2O	KCl	g kg^{-1}	g kg-1

Horizon	C	N	C/N	SOM	P_2O_5 assim.	C.S.C	ECe	Total soluble salts	NaCl	$CaSO_4 \times 2H_2O$
(cm)	g kg^{-1}	g kg^{-1}	g kg^{-1}	g kg^{-1}	mg kg^{-1}	cmol kg^{-1}	mScm^{-1}	g kg^{-1}	g kg^{-1}	wt-%

Horizon	Soluble Cations				Sum cations	Soluble Anions			Sum anions	SAR	ESP
	meq L^{-1}				meq L^{-1}	meqL^{-1}			meq L^{-1}		
(cm)	Na^+	K^{++}	Ca^{++}	Mg^{++}		Cl^-	SO_4^{--}	HCO_3^-			

Table 4. *Recommended soil parameters to be measured for a reference profile*

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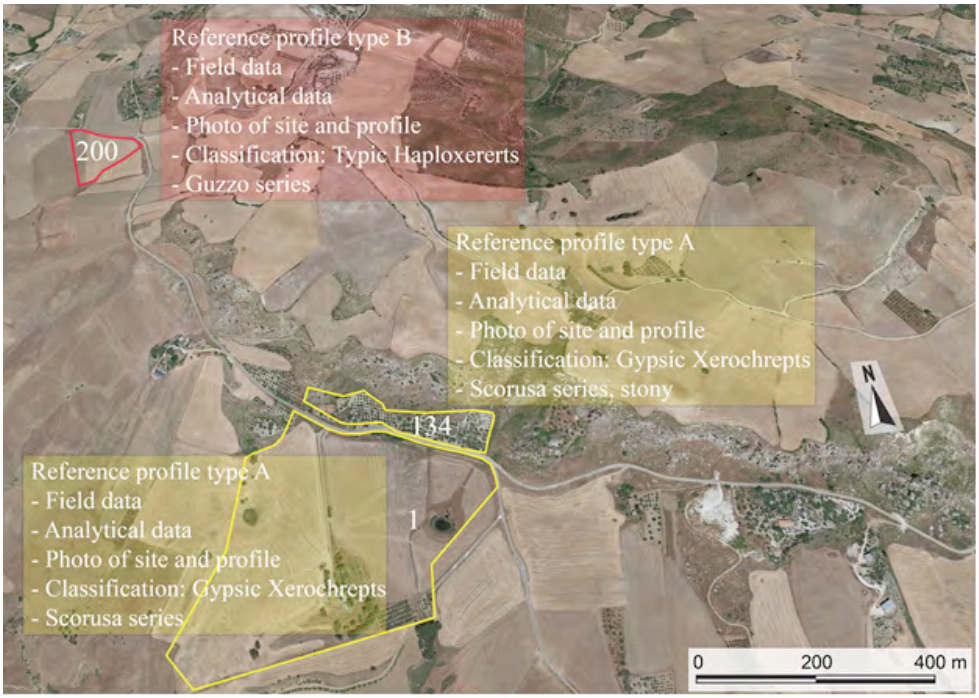

Figure 2. *Aerial photo (3-D view) of the area with reference profiles of Caccamo (Google Earth) with overlapping portions of map.*

Finally, a third case can be added to the two cases described above, i.e. when there is a change in use. In this case, it will always be necessary to proceed (even in the case of parcels having < 0.5 ha) as in the second case (surface > 0.5 ha).

Once the technician has described and given a name to the soil of the parcel, the degradation state of the soil has to be taken into account. If the parcel has a surface area ≤ 0.5 ha, the judgement about soil degradation is based on the thickness of the horizon A of the soil itself (minipits can be analysed).

In the case where the parcel is > 0.5 ha or where a changes in use is foreseen (third case), the degradation will have to be evaluated by using the official proceeding that includes the analysis of the organic matter content, salinity, erosion etc. Furthermore, the Land Capability Classification System has to be applied (Klingebiel and Montgomery, 1961). At this point the information obtained will be transferred to the cadastre by the technician either in paper form for archiving or by entering it directly into the cadastral certificate table (with a certified signature). From that moment on, the inventory (the database) has a new reference profile. All this activities will increase the pedological information of the Italian territory. The information will be made accessible to all who take care of the area.

This work drafts a first guideline that can be included in the accompanying description of the specific law, and will be addressed to the technicians who will be in charge of updating the soil information of the plots of the extra-urban soil cadastre inventory. For a better understanding, a study carried out in the territory of the municipality of Caccamo, in the province of Palermo, has been used as an example (Fig. 2). The freelance technician, in charge of completing the pedological information of the parcel, must first find the most important profiles closest to the parcel of interest. The pedologists of the soil cadastre consult the "Map of reference profiles" and determine those that need to be reported in the certificate. This document must contain a satellite image or an aerial photo as background. The inventory should allow printing and downloading the cartographic documents together with the photos and analysis. In the provided example of Caccamo there are three main profiles that are close to the parcel of interest, two of which are Type A and classified as Gypsic Xerochrepts. One profile that is located in parcel n. 1, is part of the Scorusa together with parcel no. 134 (Scorusa series, but more rocky); the third profile, Type B, is located in parcel no. 200 (Fig. 2) and classified as Typic Haploxererts (Guzzo Series). This example shows that probably in many cases the data about soils can be increased rather easily.

The collaboration between research centres, universities and professional bodies should result in final guidelines (to be applied) both for the assessment of soil degradation

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and for the application of the Land Capability. The freelance engineer should not be left alone; regardless of who does the work, the final assessments should be identical.

Discussion

Basically two original models of cadastral systems exist in the EU: 1) the Central European cadastre has a graphic basis (map) of land registration (Land Registry), so that physical changes must be reflected in the cadastre and legal changes in the Land Registry; 2) the Latin model uses the cadastre only as a taxation instrument (Comparetti and Raimondi, 2019).

The new structure of the Italian cadastre will differ from this and, as previously mentioned, will have three sections: the urban soil cadastre, the extra-urban soil cadastre or land cadastre and the cadastre for the conservation of soil-biodiversity or natural to semi-natural pedodiversity. It opens therefore new doors for land management and protection. With this work, we present a first guideline for freelance technicians who are about to use and update the soil information of parcels that are included in the extra-urban soil cadastre inventory. Starting from the data provided by the CRA-ABP database, we will create with time an inventory that will be very rich in information and that can also be used by the land market (purchasing, selling). The new buyer of a plot will be able to agree on a selling price consistent with the possible uses (if the market has no other influence). The latter will be able to know, through a technician, "what can or cannot be done" on that land. The technician, once observed and studied the soil profile of the plot, will be able to explain to the buyer all important aspects for land use. Very often, a straight relation between the soil and parent material exists in Sicily (Egli et al., 2019). This however is not the case or only limited when the soil surface has been changed and the soil amended. In order to go beyond the current state (identification and classification of the soil), more information can be requested and clarifications be obtained from the pedologists of the cadastre (e.g. the possibility of soil improvement).

The choice of the buyer will be more price-conscious. The researchers of the CRA-ABP, before defining a new profile to be included in the group of reference profiles, will have to consult the data of the cadastre where they can find all the information to express a coherent judgement. The generated knowledge about soils on the parcels included in the cadastre will allow a targeted approach to realise improvements in harmony with the characteristics of the territory itself. This means that damaging activities to soils and infrastructure can be better prevented and the sustainable use of soils and land improved.

There are several (economic) instruments to regulate land consumption and sustainable use of soils. One usually distinguishes between price-regulating (taxes, subventions etc.) and quantity-regulating (supply and demand; price) approaches (Seidl, 2015). Damages to ecosystem services should in future be compensated (Hepperle et al., 2017) or particularly well-developed sustainable use awarded. In some countries, such types of instruments are partially integrated in ordinances about land use regulations. As an example: estimates for the EU showed that the area suffering from erosion extended to 12000 km^2 entailing great economic losses, particularly for Italy (Panagos et al., 2016). Spain, together with Italy and Poland, are large EU Member States that, owing to urbanisation, experienced a loss of cropland of greater than 5% between 1990 and 2006 (Barbero-Sierra et al., 2013). Hepperle and Stoll (2006) proposed a soil-resource plan for a better integration of soil protection and management in land use regulations. Such a resource plan, that has some similarities to the soil cadastre, compulsorily needs a sufficient data basis (about soils) to be integrated in a GIS. Soil properties and effects on soils must be implemented in such databanks. In addition, methods are needed to interpret the soil data and the impacts on soils. These data sets and methods are urgently needed to counteract the loss of arable land, to maintain food security and to promote the sustainable use of soils. This type of idea already exists since 1961 (Klingebiel and Montgomery, 1961). This concept has to be applied by soil scientist (for Italy see AGR 14). A recent investigation (Olivieira et al., 2019) showed that several European countries (England, France, Italy, The Netherlands, Belgium, Spain, Portugal, Germany, Austria, Switzerland and Denmark) have developed a variety of instruments for cropland protection, which can be grouped into two rough categories: (i) prime planning instruments, that is priority areas for agricultural land-use; and (ii) complementary planning instruments, which are national targets to limit land-take and soil function assessment frameworks. Advisory expert panels and pre-emption rights for farmers and farming organisations are also applied complementarily. The findings of Olivieira et al. (2019 indicate that these instruments might be more effective, if they were legally

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binding all administrative levels and practically applied in multilevel governance arrangements – something that a soil cadastre pursues. The most important administrative level is in this context the community. Sustainable development must be a general objective of all community policies (Comparetti and Raimondi, 2019).

Conclusions

This guideline represents the first practical step in the transformation of the land cadastre into an extra-urban soil cadastre. This phase is preceded by the input of climatic and lithological data. With the entry of soil information, the transformation of the land cadastre inventory into a soil cadastre will be completed. Immediate practical consequences will be the creation of agricultural enterprises with first class facilitated entrepreneurs (these are those who are able to compete on the free market at national and international level) and decrease (even the immediate stop is conceivable) of soil degradation.

It is clear: resources need to be invested, but when fully operational the community will have an inventory in which each plot will have its own history which can be inquired by all. Access to the database should be free because the owner has the right to use the soil; the soil performs ecosystem services for the benefit of man and all living beings on Earth, animals and plants. In addition to fiscal justice and sustainable uses, the data can be used to communicate the characteristics of agricultural products from the parcel. The producer and consumer would be protected to the maximum extent. All professional bodies dealing with land and soils would have the opportunity to work more consciously and responsibly. A new economic boom on the countryside (indirect technical assistance) seems likely. Even public funding could be better distributed (controllable through the cadastral parcel).

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