THE STRUCTURE OF SOIL CADASTRE. A MODEL OF SOIL INVENTORY FOR ENVIRONMENTAL, SOCIAL, ECONOMIC AND TAXATION PURPOSES IN A GLOBALISED MARKET

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Abstract

The author shows the development of a structure, derived from the processing and integration of Ground Cadastre, where all soil characteristics are described. The soil is considered as divided according to the updated concept of cadastral parcel (soil and topographic uniformity of ownership and municipality). The land use is also assessed with reference to sustainability, taxation and environmental risk prevention. The structure of Soil Cadastre can contribute to the bureaucratic simplification of agricultural policies and environmental emergencies, as well as product presentation and traceability. Through the updating of some characteristics by professionals, the cadastre can become evidentiary and fundamental for consultancy and statistics.

Keywords: *soil, territory, inventory, soil cadastre, sustainable use*

Introduction

The soil is the most important human resource, because it provides agricultural, livestock and forestry renewable production, supports or hosts all human activities and records all climatic, vegetation and artificial variations. It pursues many other environmental purposes: production of drinkable water, biodiversity conservation, transformation of organic matter, heritage preservation and production of inert materials for building. The soil, that is also the basis for all infrastructures, for all these reasons can be defined as "super resource". If a sustainable soil use is performed, this resource can enhance its purposes and also become a refuge for investments. Being a natural body on the earth surface, it has three-dimensions: width, length and height (i.e. soil depth, from the ground surface to mother rock). If the soil is considered as a continuously developing natural body, due to the main pedogenesis processes (controlled by pedogenesis factors), it has four dimensions: time is added to the above ones. While street man is walking in an earth area, he can perceive the soil area (width and length) and the district and commonly names this resource as "ground". In fact, the soils owned by somebody are described by the following characteristics: area (width and length) and district (position on the earth surface). The term soil has a meaning also in agronomy and economics with reference to the moment when it is considered, e.g. soil tillage for tomato

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transplanting, wheat seeding, soil price in a district, in a municipality. In these sectors, the soil mass below the ground surface is considered only for fertilisation and irrigation but generally not below 40-50 cm. When climate and soil characteristics (within the taxonomic soil science) are studied, all the characteristics of the mass of soil horizons are considered (Soil Survey Staff, 2014). From the point of view of ownership right, soils can be public and private The Italian law recognises and guarantees the private ownership. Therefore, the soil is a profitable investment (refuge during some historical periods), as well as it pursues a paramount social purpose: work-related and healthy (during the old age as recreation, production task and training preventing from some pathologies common among retired people). In economics, the soil, together with the invested funds (e.g. buildings, streets, lakes, orchards, drainage systems) constitutes the land capital. The buildings, outside cities and towns, should be divided in two categories: rural and residential. Rural buildings are those belonging to agricultural, livestock and forestry production of soils: stores for agricultural machines and reserves (living and dead) and for owner or tenant residence. Rural buildings should not have a taxation distinct from soils, because they belong to farm production and the income for land capital should be taxed accordingly. This is more valid in hill and mountain districts, often missing suitable streets and facilities (e.g. drinkable water, gas, lighting, territory control). Residential buildings are those located near the national, provincial and municipal roads and are not tightly related with the agricultural production of adjacent soils or those of the same municipality. These buildings should be considered as the urban ones. In the farm culture of the past the small land area owned by a family had a high affection value and the love for soil was paramount, because it guaranteed employment and satisfied the food needs. The continuous presence of man in the fields allowed people to use their free time for water drainage, maintenance of engineering works (e.g. terracing, channels, roads, buildings, boundary walls) and pruning of river trees or boundary bushes. The run-off water was slowly flowing and it often prevented from floods and landslides. The artificial landscape of terracing, that is nowadays promoted, was obtained by means of many hours of not paid work. Yet, nowadays, in a period of employment crisis, this landscape is appreciated though agritourism. The national policies try to support the private initiative of individual or group (also with funds and tax cuts) for developing the social and environmental purposes of soil and the work of farmer. This is in contrast with the activities of multinationals of financial capital or capitalistic enterpriser (he owns all the means of agricultural production), whose only objective is the profit, by sacrificing the environment and man works, as well as his freedom and dignity (exploitation of production factor work and recruitment of day laborers). Nowadays in some territories the production capacity of soils is less important than other purposes: the soils contribute to fight against the desertification and prevent from environmental disasters (Raimondi, 2014b), e.g. landslides, floods and drought. Many people, also of other culture, not always

succeed in understanding these soil purposes or show a suitable environmental sensitivity.

The territory is everything is inside an area of earth surface (within physical, administrative, political or personal or farm ownership boundaries), both above and below the ground surface, without height or depth limits. The soil is a part of the territory, whose knowledge and development are studied by Applied Soil Science. This subject is fundamental for all human activities and environmental protection. Applied Soil Science deals with soil and territory evaluation, e.g. soil fertility, Land Capability, Land Suitability, Land Classification system, soil mass evaluation for engineering objectives, evaluation of sustainable territory uses, evaluation and management of environmental emergencies, environmental impact assessment of a work or a (implemented or planned) management method. These studies are fundamental for keeping or enhancing the purposes of the resources soil, water, clean air in pleasant territories.

The new Community Agricultural Policy (CAP) 2015-2020 is conceived as environmentally sustainable and revolutionary with reference to the past. This policy tends to protect the environment and guarantee a profit to farmers. In order to achieve the pursued results, farm and territory projects must rely on the territory and environment knowledge, above all in a period characterised by high climate changes (Rana et al., 2016). This information is often distributed in different administration offices and its collection is not always possible within a short planning time. The soil and territory information (on climate, outcrop, morphology, vegetation, historical and/or prehistoric artifacts) can be easily appreciated and used through the creation of a hub managed by the public administration, where all data are merged and the whole area of Italy is shown. This structure was the Ground Cadastre, that must be converted into Soil Cadastre. The new structure would allow to avoid further failures of CAP, because the professionals could easily find the data and use them according to well-known methods, that are implemented all over the world. In fact, in a globalised market, it is fundamental to recognise the rights of all human beings, not only enterprisers and consumers, as well as all environment parts.

In this perspective it is fundamental to review the Ground Cadastre, in order to easily implement and manage the sustainable soil uses, according to their climatic, lithologic, hydrologic, soil science, vegetation and market characteristics (Raimondi, 2014c). The soils are always subjected to taxation, because they produce a profit. The Ground Cadastre was planned for taxation objectives, by relying on distinct census areas. Recently the Unique Municipal Tax ("Imposta Municipale Unica" - IMU) was applied to some Italian agricultural soils. As powerful computer science means are nowadays available for data processing, it is possible to create an inventory where the same sustainable soil use in different areas of Italy is proportional to the capacity to produce profit, according to a division in fee categories, based on actual data and aimed at achieving a more fair tax justice.

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The history of Soil Cadastre

According to the first proposal of restructuring the ground cadastral certificate (Raimondi, 2013) other two columns were added: "soil taxonomic family" (Soil Survey Staff, 2010, 2014) and "Land Capability Classification" (Klingebiel and Montgomery, 1961).
Then the information was integrated with the district, constraints and requirements (constraints related to the parcel management), aimed at sustainable soil use, valorisation of not used or under used areas for objectives different from agricultural production, as well as reducing soil consumption and waterproofing (Raimondi, 2014a).
Finally the regulation of the splitting up of agricultural lands was proposed, in order to prevent from the excessive division of the parcel areas and define an updated concept of cadastral parcel, based on soil and topographic characteristics (Raimondi, 2014b).
In October 2014 a new calculation method of "reddito dominicale" ("owner income") and "agricultural income", according to the effective crop balance of the current year and actual environmental soil purposes, was proposed and, therefore, other two columns were added to the ground cadastral certificate: "tax deduction" and "tax added" (Raimondi, 2014c).
Some examples of implementation of crop balances are proposed in this work. With reference to soil, topographic and climatic characteristics, it is needed to distinguish among arable land, pasture and uncultivated soil.
Lonzi proposed two projects to Sicilian Region: a survey on the abandoned or roughly cultivated soils and the livestock census, both to be carried out by a youth cooperative, according the Regional Law n. 285 of 1977 (concerning with the youth employment). By relying on the first project the law n. 440 of the 4th August 1978 of Italian Republic, (Italian Parliament, 1978; Lonzi, 2017) was issued, in order to try to enhance soil use. The uncultivated area in Sicily is nowadays 355,300 ha ca., that is almost equal to the area of Catania province (Lonzi, 2017). Official data on the uncultivated soils are missing. By using the principles and the structure of Soil Cadastre, this piece of data would be immediately computed, according to Land Capability Classification. From 1970s until today the method for distinguishing arable land from pasture during soil sensing was highly discussed among soil surveyors. Dry arable lands were and are similar to pastures, according to the current year of crop rotation, and, therefore, could be considered as arable lands, if durum wheat was cultivated, or pastures, if the fallow land is used by animals. Therefore, as the soil is a tax source for the government, if it is a land that can be ploughed (Land Capability categories I, II, III and IV), it should be always considered as arable land, with or without animals inside the parcel. Thus the tax would not be reduced according to a principle of tax justice, because the forage mass produced in a well-managed arable land is much higher than in a pasture. The production of dry matter in an arable land is always higher than in a pasture, so that the green can be cut (the soils have a higher fertility and an easier traffic of agricultural machines).

If the owner cannot manage his soils, because he has no or not enough agricultural machines or his main activity is different from agriculture, the tax should be computed according the ownership area (able to create an autonomous farm), as well as the land position, i.e. if it is located in a coastal or inland flat or hill or mountain. For example, the minimum area for defining a farm as autonomous in Sicily could be: 50 ha for mountain ones, 25 ha for hill ones, 5 ha for dry inland and coastal flat dry ones and 2.5 ha for irrigated inland and coastal flat ones. This division in categories can be carried out by adding another column to the soil cadastral certificate: "irrigated district". The tax should be computed for the arable lands having an area lower than the minimum one as well as for pastures, whereas for those having an area equal or higher than the minimum one as well as for arable lands. Every year the "Intended soil use (Quality)", i.e. the species, could be modified by the consultant (agronomist) of the owner through the access to the information system of Soil Cadastre. The column "Intended soil use (Quality)" could be modified, while the "Specification of the agricultural use: crops and class or other", i.e. the crop yield level, should be immediately shown. Moreover, "tax deduction" or "tax added" should be included in the related columns, respectively. The tax deductions are costs that the owner yearly supports and not included in the "owner income" (e.g. those for building a channel or artificial lake by land reclamation authority). The tax deductions for arable lands should be computed also relying on the interventions for preventing and fighting against desertification (Gazzara and Raimondi, 2012a): more sustainable is the soil use higher is the deduction, whereas more expensive is the management higher is the deduction. A higher tax deduction should be computed for pastures where animals have left a vegetation enough high for protecting the soil from erosion, best practices of conservation of plant and landscape biodiversity, as well as preservation of water resources, were implemented, without fires, erosion and soil, water and air pollution during the current or previous years. In the environments where aquifers can be used for supplying drinkable water, the pasture should be more controlled or forbidden, the arable land should be forbidden and even a further tax deduction or removal should be implemented, in order to create state-owned areas for aquifer protection. At the end of the current year, if the profit is negative, the government should reimburse the owner. On the contrary, in soils characterised by an unsustainable use or management and degradation processes of soil or landscape or aquifers or air, a "tax added" should be implemented for the owner of tenant that pollutes or reduces the crop yield, because of infrastructures built in the adjacent parcels or in the surrounding district. This "tax added" should allow to constitute a specific fund to be used for supporting costs when floods or landslides or avalanches or soil or aquifer pollution happen. The soils characterised by a high risk of landslides or floodplains of big rivers (e.g. Po) or avalanche gorges should not be used as arable lands or for building houses. These soils should be used as pastures or woods or generally for the conservation of animal and plant biodiversity. The use of these soils should be assessed and decided by a committee

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of geologists, climatologists, soil scientists, forestry doctors, botanists, zoologists, hydraulic engineers and agronomists (Raimondi, 2014a). After their assessment, these soils should not be modified by any professional. These soils could be graphically represented by means of Geographic Information System (GIS) and the costs for their remediation should be supported by the above fund. During this period the owner has a negative profit, and, therefore, he should not pay any tax for them.

For the lands that can be ploughed (Land Capability categories I, II, III and IV), subjected to erosion (Raimondi e Interrante, 2014), landslides (Raimondi et al., 2007; Raimondi e Farruggia, 2008; Raimondi e Calcaterra, 2011), salination (Gazzara e Raimondi, 2012 b; Raimondi et al., 2010), waterproofing (Raimondi, 2014 a), reduction of organic matter and compaction, these conditions should be communicated to the parcel owner through the column "Requirements" (constraints related to the parcel management) of soil cadastral certificate, in order to invite him to enhance the management in a well-defined period, by varying the crop rotation, organic and mineral fertilisation, irrigation, green manure, sustainable weed control in the inter-raw without chemicals or waterproofing (in areas rich of pollutants that could be transported by water during a period as shortest as possible from the beginning of remediation intervention).

Expected results

Since the ancient times the main objectives of the Ground Cadastre were concerned with taxation, law (evidentiary value of rights), topography, economics and statistics (splitting up of agricultural lands), mean crop yield, distribution of crop quality (cultivar), rural buildings, capital land of individuals, etc. (Di Trapani et al., 2007).

The Ground Cadastre was created at the end of 1800s as a massive and a high value work for engineering, economics and taxation. It became fundamental for computing the taxes that must be yearly paid by land owners. Since its establishment was subjected to changes, both as ground cadastral certificate and updating of crop quality and category, also the soils were changed and sometimes artificially for specific crops or soil uses (e.g. protected crops). Nowadays a parcel having the same crop quality and category, e.g. only olive, unfairly has a "owner income" lower than another similar but having arable land with tree olive plants in less than 50% of its area. In these parcels the arable land cannot be cultivated by using agricultural machines. Therefore, the updating of these parcels is needed.

The Soil Cadastre, according to the proposed project, would allow to prevent from the excessive division of the cadastral parcel areas during the splitting up of agricultural lands and a new better concept of cadastral parcel, taking into account also the uniformity of the mass of soil horizons (development of soil mass) and altitude band (flat, hill or mountain).

The proposed Soil Cadastre, entirely computerised, would have a high range of applications, besides taxation objectives (in purchase agreements). The new

structure would allow the owners and farmers to pursue a sustainable soil use and management.

Each human activity aimed at changing soil use and management should be assessed for its environmental sustainability (with reference to soil, water, air, landscape and animal and plant biodiversity). This project is fundamental for protecting the crop yield and environment of soils and let future generations to reinherit them. Thus the government can stop desertification (reduction of the capacity of an environment or territory to support human beings), keep crop yield and its competitiveness at international level in a globalised market. The spread sustainable soil uses enhance the habitability of the territory and its pleasantness from the touristic point of view, because they allow to integrate the different landscape parts. They would implement an activity of prevention from environmental disasters, the concept of soil as common resource pursuing a paramount social purpose, soils pursuing purposes of recreation and health preservation (for retired people and workers of sectors different from agricultural one), an uniform product certification for farmers for the same product and environmental impact, sensing made easy by means of more and more accurate positioning systems (GPS), accurately sensed parcel boundaries, implementation of the minimum distance of plants, rows and infrastructures from parcel boundaries, absence of litigation in the countryside, better investment of capital in rural buildings, orchards, roads, walls, etc. The "vegetation abuses" carried out in agricultural territories and, above all, urban ones (when the above criteria are violated) could be easily identified. Also the cost of extraordinary maintenance of rural buildings and infrastructures could be correctly evaluated at national, regional and municipal levels, in order to implement a suitable policy.

The new soil cadastral certificate, including the environmental, territorial, economic and social information, would allow a better taxation justice through the payment of taxes according to the actual crop profit and territorial impact (with reference to roads, railways, houses, cities, towns and villages, industrial and trade areas, etc.).

Nowadays this is possible, because a huge amount of soil and territory information is available on raster and vector maps, that can be easily updated by using images from remote sensing, acquired, logged and processed for deriving the lithological, soil and environmental history of each parcel (Raab et al., 2017). If, besides the environmental, territorial, economic and social characteristics, also the column related to the parcel owner would be updated, due to ownership changes logged on-line by the notary, it would be possible to create an evidentiary inventory that would allow to accurately identify the parcel owner.

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Logo of Territorial Agency	Soil Cadastre Request data	Municipality of Corleone (Code: xxx) Province of PALERMO	
	Name and Surname_____	Sheet: 200	Cartographic data
	Street_____	Parcel: 22	Official Italian Cartography:
	City_____ZIP Code_____		F. (Sheet) 258 II NO Corleone (scale 1:25,000)
	Tax Code_____	Entry: 12	Regional Technical Map: _____(scale 1:10,000)
	1ST ACCESS	2ND ACCESS	Detailed Cartography: _____ (scale 1:5,000 or higher)

N.	PERSONAL DATA	TAX CODE	ACTUAL RIGHTS AND DUTIES
1	Pinco Pallo born in Corleone on 22/02/1996 resident in Palermo in Street Fresca, 32	_____	Ownership 1/1 in community of property
2			
DATA RESULTING FROM:	ISTRUMENTO (PUBLIC DEED) of 21/03/1995 Transfer of registration n. 2500 1/1995 in deeds from 10/08/1996 (record n. 300132) Collection n. 52893. Rogante: CELESTE Aida. Offices: PALERMO. DIVISION		
MANAGEMENT *(1)*	Direct by owner (or tenant) 3RD ACCESS		

Identification data						Resulted 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 Sicani	Biological

Enviromental data									
Climate (Thorathwaite) *(5)*	Lithology *(6)*	Soil Taxonomic family *(7)*	Altitude band (m a.s.l) *(8)*	Mean slope (%) *(9)*	Predominant Exposure *(10)*	Rockiness (R) Stoniness (S) *(11)*	External drainage *(12)*	Position of temporary hydrographical network *(13)*	Solum thickness (cm) *(14)*
C_2 B_1' s b_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)*	Access 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 Dominicale	Income Agricultural	Tax deduction (D) € *(27)*	Tax Addition (E) € *(28)*
					Yearly computation € *(26)*			
Grazing	Pasture 2	Sustainable	C1	1 36 97	100	20	D3 30	- -

Table 1. *Example of new soil cadastral certificate.*

(1) Management: direct (owner or family) or tenant (the rent agreement recorded and signed by the owner and by the tenant is mandatory).
(2) Central point coordinates: geographical coordinates. It is the fourth way to access the soil cadastral certificate.
(3) Production sector: e.g. tracks of the cheese of Sicilian mountains or DOC wine, DOP (Protected Designation of Origin) and IGT (a class of Italian wine appellation) Marsala, Victory, Eloro or cherry tomato of Pachino or pistachio of Bronte or Vastedda of Belice or prinkly pear of Santa Margherita Belice or San Cono.
(4) Agriculture type: traditional or integrated or biodynamical or precision.
(5) Climate (according to Thornthwaite). C2 B1' s b3'. Where: (C2) climate type from humid to subhumid; (B1') climatic variety first mesothermic; (s) moderate water deficiency in summer; (b3') summer concentration of thermal efficiency from 51.9 to 56.3.
(6) Lithology. Limestone. Where: formation of limestone of Corleone ("Burdigaliano-Langhiano inferiore").

(7) Soil Taxonomic family. Entisoil: T U, f, m, m, where: (T U) Typic Udorthents, (f) loam, (m) mixed, (m) mesic.
(8) Altitude band. Min and Max. Where: (Min) altitude of the lowest point of the parcel; (Max) height of the highest point of the parcel.
(9) Mean slope. Where: (average slope) expressed as % or the tilt angle of the field plane expressed as degrees when the tilt angle is equal or higher than 45°.
(10) Predominant exposure. N, S, E, W. Where: (N) North, (S) South, (E) Est, (W) West.
(11) Rockiness and Stoniness. Where: (Rockiness R) indicates rock outcropping or emerging (on soil surface), that cannot be removed by means of a bulldozer and, therefore, is a factor limiting the soil depth (generally near the rock) and increasing the cost of field operations. (Stoniness P) indicates fragments of hard rock (on soil surface), having an average diameter higher than 2 mm. These fragments are evaluated by considering their incidence on the area unit (expressed as %).
(12) External drainage. Where: (external drainage) indicates the speed of run-off water, which does not infiltrate. It is expressed by means of an adjective: a) very poorly drained, i.e. water stagnation for a long time; b) little drained, i.e. water stagnation preventing from the crop growth during a period; c) imperfectly drained, i.e. reduced crop growth, that requires a drainage system; d) moderately drained, i.e. slow water disposal with beginning of ochre speckles below 50 cm depth; e) well drained, i.e. normal water disposal (without causing erosion); (f) very drained, i.e. fast water disposal, causing erosion furrows; g) excessively drained, i.e. very fast water disposal, causing gully erosion. For a), b) and c) drainage works are needed, while for f) and g) works for controlling run-off water are necessary.
(13) Position of temporary hydrographical network. Present or missing: geographical coordinates (sensed by means of GPS) of beginning and end (intersecting the parcel boundary or other, e.g. doline ponor) points of this network.
(14) Solum thickness. Where: (Solum) is the average thickness of the layer explored by most plant roots.
(15) Mountain. Mountain or Not Mountain. Where: (Mountain) indicates a mountain cadastral parcel; the concept of mountain municipality is suppressed. The condition of a mountain parcel is expressed by at least one of the following limitations: a) climatic restriction, i.e. the whole parcel is located on a mountain that affects the vegetative activity of plants and, therefore, the crop selection (territories having altitude equal or higher than 700 m a.s.l. for Central and Southern Italy, including islands, equal or higher than 600 m a.s.l. for Northern Italy, according to the Italian Institute of Statistics - "ISTAT"); b) limitation due to the slope in the hilly and flat territories (territories having altitude between 300 and 700 m a.s.l. and lower than 300 m a.s.l. for Central and Southern Italy, including islands, respectively, according to ISTAT); the slopes are steep (often characterised by high stoniness) and are not easily travelled on foot, due to rock fragments. The slopes affect the use of agricultural or industrial machines, as they cannot move, or increase the risk of surface or mass (landslide) erosion. The slope becomes a limiting factor when is equal or higher than 35%; (c) limitation due to the widespread outcropping rock (hard or soft). These territories belong to flat and hilly ones (according to ISTAT), where pedogenesis is stopped; the soil particles that are originated from the hard rock are transported by water and/or wind and/or gravity force. This category also includes badlands, areas characterised by landslides and inert materials derived from sulphur extraction ("rosticci"); d) limitations due to soil characteristics. When the soil is not enough deep, its mass can reduce the plant growth. Generally these soils have a depth of "solum" lower than 30 cm or are flat and marshy, due to waterproof horizons and moving water (reduced internal water drainage) or because they are flooded from an adjacent river. (Not Mountain) indicates other soils, different from the above ones.
(16) Constraints. Where: (Constraints) from latin "vinculum", meaning bond, e.g. in soil management, i.e. a better management with reference to the territory characteristics. List of constraints: a) Constraint of stability of buildings, water management, ponds and wells, managed by Public Works Office; b) Hydrogeological constraint, managed by Regional or National Forestry Unit; c) Constraint related to wetlands belonging to the permanent hydrographic network (regulated by Law "Galasso"), managed by the Authority of Cultural and Environmental Heritage; d) Natura 2000 network - Sites of Community Importance (SCI) and Special Protection Areas (SPA), managed by a municipality and Territory and Environment Department; e) Parks and reserves, managed by the Park or Reserve Authority of Territory and Environment Department; f) Hydrogeological arrangement plan (areas characterised by landslides or flood risk), managed by the Territory and Environment Department; g) Forestry and fire protection plan, managed by the Sectorial Forestry Inspectorate; h) Hygiene and health for industrial or agro-industrial activities, managed by the Provincial Health Public Utility ("ASP"); i) Waste plan (activity of landfills and waste management), managed by the Department of Energy and Public Utility Services; l) constraint of biodiversity conservation, managed by the Authority of Cultural and Environmental Heritage. In the example shown in Table 1 there are the constraints (Ab), (Al) and (Aa), where: (Ab) Hydrogeological constraint (it is needed a permanent protection by ensuring an uniform plant cover higher than 10 cm); (Al) constraint of biodiversity conservation; (Aa) constraint for the protection of water for keeping it as drinkable (there is the source of Prizzi aqueduct).
(17) Access roads. B1, B2, B3, B4 and B5. Where: (B1) indicates a national road ("SS"); (B2) indicates a provincial road; (B3) indicates a municipal road; (B4) indicates a road splitting up fields, (B5) indicates a farm road. In

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the example shown in Table 1 there are the roads (B1) and (B3), where (B1) indicates a national road (188) and (B3) indicates a municipal road.

(18) Water availability. Yes or No. Where: (Yes) indicates the availability of water resource for irrigation or supplying the animals. A chemical, physical and microbiological analysis certificate and an assessment one on the possible uses of the available water are linked to the soil cadastral certificate.

(19) Pollution. It distinguishes the soil masses according to the pollutant type, by showing all the available data by means of an optional link upon request. Moreover, it provides information on the pollution process and the eventual movement of pollutants towards other environmental parts (water and air). The site characterisation is more important for the next land reclamation. If the site is not characterised it is necessary to indicate the need for characterisation. Moreover, soil pollution determines almost all the data of rating, e.g. soil use (agricultural and/or forestry uses cannot be implemented) and specifically computed taxes (tax added, together with the obligation for the owner to carry out the land reclamation if he is guilty).

(20) Unit of Use Capacity (Land Capability Classification). It is the lowest level of evaluation according to Land Capability Classification (Klingebiel and Montgomery,1961). This evaluation method aims at preserving or enhancing soil fertility (sustainable soil management), above all by stopping soil erosion (action of preventing from damages due to erosion). In the example shown in Table 1 VIIe5 indicates: (VII) seventh class, i.e. soil that cannot be not tilled (only to be used for pasture, forestation and conservation of biodiversity and water resources); subclass (e) erosion, for the current process; a Unit of Land Capability (5), i.e. past high erosion.

(21) Intended use (Quality). In the example shown in Table 1 it is the crop or infrastructure quality, i.e. the current soil use. Where: (grazing) indicates that the grass production is used for the sheep grazing.

(22) Specifications of agricultural use: crop and class or other. In the example shown in Table 1 the use is arable land; this column shows the crop within a rotation (this piece of data can be yearly changed by an agronomist). In the example shown in Table 1 there is a pasture of second class.

(23) Physical sustainability of the specific soil use. Sustainable or not sustainable. The specific soil use is physically sustainable if the current use and management matches the class of Land Capability. Sometimes the specific use is sustainable but the management causes soil degradation, e.g. erosion or flood. Where: (sustainable) indicates that the crop and its management are sustainable. In the example shown in Table 1 the pasture and its management are sustainable; the height of forage plants is not lower than 10 cm; if (unsustainable) is shown, the requirements are included in the next column. These interventions must be implemented within a well-defined period.

(24) Requirements. C1. It shows the eventually needed interventions for unsustainable use, in order to establish a sustainable use. Where: (C1) indicates missing requirements, because the current use and its management are sustainable, as evaluated by means of remotely sensed images (from satellites or aircrafts) or scouting. The distribution of tree plants in the pasture (pasture with tree plants) contributes to prevent from erosion and is a refuge for animals in the wild during the rainy and winter periods, above all when the snow covers the land. The codes C2, C3 and C4 indicate specific interventions, e.g. drainage furrows (C2), control of runoff water by means of ditches (C3), green fallow or increase of forage crops inside the rotation (C4).

(25) Area expressed as m^2, divided according agricultural measurement units, i.e. hectare (ha), "ara" (100 m^2) and "centiara" (ca) (1 m^2). In the example shown in Table 1 the parcel area is 1.36.97 ha, i.e. 1 ha, 36 "are" and 97 "centiare".

(26) Income. "Reddito dominicale" ("owner income") and "agricultural income" yearly computation. In the Ground Cadastre the computation of these two incomes is performed through rural valuation criteria and is periodically updated. In Soil Cadastre the above incomes are computed by considering the production data of the current year, the supported expenses and market prices (yearly profit). In some years, e.g. for drought, the above incomes result negative, so that the government should provide the owner with an allowance. When an owner (e.g. retired person or worker whose main activity is different from agriculture) has a total area (of soil owned or received on a gratuitous loan) equal or lower than 0.5 ha for flat areas, 1 ha for hilly ones and 2 ha for mountain ones, he has not to pay taxes, because the agricultural activity pursues a social purpose (e.g. urban vegetable gardens). In the example shown in Table 1 the "Reddito dominicale" is € 100, while the "agricultural income" is € 20.

(27) Tax deduction. When a sustainable crop and land management is implemented, even by supporting costs higher than the usual ones, a tax deduction or reimbursement is acknowledged. The amount of tax deduction is evaluated by relying on remotely sensed images and/or laboratory analysis results and/or data sensed in the field. Where: (D1) indicates a specific management of the grass height for biodiversity conservation; (D2) highlights a specific management of pasture, implicating a short staying of animals, in order to protect aquifers supplying drinkable water; (D3) indicates high storage of organic carbonium (C) in the soil mass. In the example shown in Table 1 (D3) indicates a tax deduction of € 30, as prize for high storage of organic carbonium, due to a sustainable soil management.

(28) Tax addition. When an unsustainable soil management is implemented, a tax added is applied for environmental or territorial damages caused in the past or present (without retroactivity). The tax added is proportional to the caused damages, that are quantified by means of remotely sensed images and/or laboratory analysis results and/or data sensed in the field about soil but also water and air.

Definition of parcel of Soil Cadastre. The parcel of Soil Cadastre is characterised by uniform soil type (classified as taxonomic family or series) and crop yield, is located in the same municipality, map sheet, without infrastructures and permanent hydrographical network (if it is removed during the summer, it is originated again through usual or exceptional rains) breaking the territorial continuity, is characterised by the same altitude band (according to the above ISTAT classification in flat, hilly and mountain territories) and belongs to the same owners having uniform rights (ownership or usufruct). The private farm roads, that do not produce any income (so that the owner does not pay taxes for them), are shown on the map sheet with a number of cadastral parcel, while the other roads and the permanent hydrographical network are not numbered. All these elements are shown together with a respect band.

Processing of map sheet. Before drawing cadastral parcels of Soil Cadastre on the map sheet, the permanent hydrographical network must be drawn with the scale of 1:2000 or 1:4000 or through clear map symbols. Each map sheet must have a legend, including the map symbols, together with the width of each segment of the permanent hydrographic network and the geographic coordinates of geo-referenced beginning and end points. Sometimes two points are identified for each end. Both the permanent hydrographical network and the roads are shown together with the related respect bands.

Conclusions

Works on the soil cadastre of various EU countries were written by several authors (Clergeot, 2003). In some EU countries (e.g. UK) the electronic processing and delivery of soil cadastre data to customers was accomplished (Collis et al., 2002).
Many EU countries felt the need of updating their cadastral system and computerising it (Cadastral Information System), in order to improve the services for customers. In the recent years the updating of cadastre was accomplished through the collaboration of many professionals external to the cadastre itself (Conejo Fernandez, 2003).
Spanish Government's Official Performance Programme of the Spanish Presidency of the EU Council (in the first semester of 2002) included the initiative proposed by the Spanish General Directorate for the Cadastre to hold the "First Congress on Cadastre in the European Union". The main objective of this conference was to study the role that the Cadastre should play within the EU and the methods that could facilitate the integration of existing national models towards a system including enough elements common to these models. Therefore, the Spanish Directorate General for the Cadastre presented, among other interventions, two specific initiatives to progress in the aim of coordination: the project for a "Declaration of the Cadastre in the European Union", and the creation of a Cadastre Permanent Committee (Durán Boo, 2002).
Yet, in most EU countries the soil cadastral certificate includes many topographic data but no reference to soil characteristics.
In this scenario the structure of soil cadastral certificate and the map based on the concept of the soil uniformity of cadastral parcel (together with the shape of permanent hydrographic network) proposed in this work results innovative: it would allow the sustainable soil use and the identification and valorisation of the environmental purposes of soils, as well as to perform best practices on the environment and territory and achieve a more fair taxation justice.
Every year the taxes could be computed according to crop yield and owner profit, environmental purposes and avoided damages through the sustainable

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management. This would allow the government to highly reduce the cost to support for remediation interventions for environmental emergencies.
Also regional, national and European funds could be distributed according to more fair criteria, by relying on the actual conditions of the places and ownership right, without any request by the parcel owner.
The Soil Cadastre could pursue also another purpose for the society, i.e. the traceability of agricultural products through a suitable code (QR code), written on the package. By reading this code it would be possible to recall backwards all the stages of companies that have loaded the product until the production farm. For example the amount of processed grape and the number of wine bottles produced in a cadastral parcel could be shown, the parcel where the grape was produced could be observed, the remotely sensed images related to this parcel could be analysed and the related soil cadastral certificate including the district, DOC (Designation of Origin) or DOCG area (label guaranteeing the quality and origin of a wine), sustainable soil use and management and eventual requirements could be printed. As the small or recently constituted DOC areas could be difficulty identified in a globalised market, the region of origin (e.g. Sicily - Italy) could be included in the bottle label as big characters (below DOC or DOCG name).
When a natural disaster (drought, contribution to the market price of agricultural products, contribution to the profit) happens, the public interventions could be quickly and easily managed and accomplished and the parcel owner could be provided with fair allowances, without a written request by him, according to the so called bureaucratic simplification (Raimondi et al., 2003). At the same time the parcel owner could be easily compensated through the due taxes. Besides the taxes, also the allowances should be computed by public offices, according to the produced profit and/or damages the farm was subjected, by relying on all the values included in the soil cadastral certificate and the sensed and mapped damages. This new structure of Soil Cadastre would produce a high advantage for public offices, farms and professional associations dealing with environment and territory. In fact, through the Land Capability the agronomist would provide parcel owners and farmers with requirements useful for land enhancement and territory transformation from dry to irrigated one. If the new structure of Soil Cadastre would be applied also to urban soils or soils to be urbanised (by constituting a specific section of Soil Cadastre), architects and engineers could use a fundamental tool for a correct territorial planning of public or private green areas (selection of plant species based on the soil quality), by collaborating with agronomists or forestry doctors.
The Ground Cadastre would be converted into Soil Cadastre, i.e. an inventory pursuing many purposes, as well as that existing in some European countries.
For example in Germany, Austria and Switzerland very complex inventories have been established, in order to guarantee the land security (Hawerk, 1996).
The new Soil Cadastre should be easily accessed by everybody and would allow to download soil cadastral maps and certificates, together with the chemical, physical and microbiological analysis certificates and assessment ones about the possible

uses of the available water (e.g. for polluted soils), as well as in the inventory of Canton Ticino of Switzerland (Canton Ticino of Switzerland, 2018).
In the perspective of the proposed project the structure of Soil Cadastre, besides its updated economic and taxation purposes in a globalised market, will make the owner of each cadastral parcel a sustainable agricultural, livestock and forestry producer, i.e. an environmental protector of the current society.

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LA STRUCTURE DU CADASTRE DU SOL. UN MODÈLE D'INVENTAIRE DES SOLS POUR LES QUESTIONS ENVIRONNEMENTALES, SOCIALES, ÉCONOMIQUES ET BUDGÉTAIRES DES SERVICES DANS UN MARCHÉ GLOBALISÉ

Résumè

L'auteur explique la réalisation d'une structure, derivè de la transformation et de l'intégration du Cadastre Foncier, ou sont descrit toutes les caractéristiques du sol. Le sol selon le concept de parcelle cadastrale est divisé pour l'uniformité pédologique, et topographique, pour la propriété et poure la municipalité. L'usage du sol est évalué par rapport à la soutenabilité, à l'aspect fiscal et à la prévention des risques en général. Le système, en plus d'une simplification bureaucratique des politiques agricoles et des urgences environnementales, peut contribuer à la présentation et à la traçabilité des produits. Grâce à la mise à jour de certaines caractéristiques, le cadastre peut devenir probant et fondamental dans le domaine professionnel et statistique.

Mots-clés: *sol, territoire, inventaire, cadastre du sol, utilisation durable*.

LA STRUTTURA DEL CATASTO DEL SUOLO. UN MODELLO DI INVENTARIO DEL SUOLO PER FUNZIONI AMBIENTALI, SOCIALI, ECONOMICHE E FISCALI IN UN MERCATO GLOBALIZZATO

Riassunto

L'autore espone la realizzazione di una struttura, derivata dalla trasformazione ed integrazione del Catasto Terreni, in cui sono descritte tutte le caratteristiche del suolo. Il suolo è considerato suddiviso secondo il concetto aggiornato di particella catastale (uniformità pedologica, topografica, della proprietà e del comune). Anche l'uso del suolo è valutato in relazione alla sostenibilità, all'aspetto fiscale e della prevenzione dei rischi ambientali. Il sistema, oltre ad una semplificazione burocratica delle politiche agricole e delle emergenze ambientali, può contribuire alla presentazione ed alla tracciabilità dei prodotti. Attraverso l'aggiornamento diretto di alcune caratteristiche da parte dei professionisti, il Catasto può diventare probatorio e fondamentale nel campo professionale e statistico.

Parole chiave: *suolo, territorio, inventario, catasto del suolo, uso sostenibile*.

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