STATISTICA, anno LXXIII, n. 1, 2013

OFFICIAL ENVIRONMENTAL STATISTICAL INFORMATION IN ITALY

Daniela Cocchi
Dipartimento di Scienze Statistiche, Università di Bologna, Bologna, Italia
Marco Alfò
Dipartimento di Scienze Statistiche, Sapienza Università di Roma, Roma, Italia

1. INTRODUCTION

In Italy, information regarding the nationwide state of the environment and environmental trends is produced by various institutions, including the National Institute of Statistics (ISTAT), the Institute for Environmental Protection and Research (ISPRA), the Italian Ministry for the Environment, Land and Sea (IMELS) (see http://www.minambiente.it), the National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) and such private non-profit organisations as Legambiente among others. For an interesting public-private collaboration see Legambiente and Dipartimento della Protezione Civile (2011). ISTAT and ISPRA participate in the SISTAN (National Statistical System) along with several other institutions providing statistical information on the environment. The SISTAN was established under the Legislative Decree 322/1989 to rationalise the production and publication of information and to optimise resources allocated to official statistics. The participating institutions have different roles and responsibilities, different degrees of access to information on economic and social issues and therefore different skills to link environmental and related anthropogenic pressures. With respect to the European Union, the European Institute of Statistics (Eurostat) and the European Environment Agency (EEA) are responsible for environment-related topics that are often complementary but sometimes overlap, with the consequence being that their coverage and comparability do not seem to be harmonised, at least at present, see, e.g. EEA (2010).

Indeed, quantitative information on the environment might be collected and released in non-uniform and non-standardised ways as a result of the institutional purposes of different agencies. The definitions of the concepts to be measured, the spatial and temporal coverage, the procedures for data collection and the statistical quality of the data are notably variable. Quantitative socio-economic information can be linked to environmental data to measure the impact of human pressures on the environment according to a more focused perspective in which the potential influence of human activities on the environment, in its broadest definition, is properly taken into account. An interesting example is ENEA (2013), a report on Energy and Environment; however, this report focuses on issues that will not be discussed in this context.

In this work, we focus on and recommend procedures to assess the coverage and comparability of official environmental information on water and soil at different levels of aggregation using the activities of ISTAT and ISPRA with relation to these themes as a working example. The structure of the paper is as follows: Section 2 briefly describes ISTAT and ISPRA structures and their links to corresponding EU structures. Several details regarding the impact of the EU Directive INSPIRE (2007) are summarised. In Section 3, the current status of collection and dissemination of environmental information in Italy is discussed. In Sections 4 and 5, we summarise the available information on issues related to water and soil, respectively. The last section is devoted to conclusions and possible developments.

2. ISTAT AND ISPRA ACTIVITIES ON ENVIRONMENTAL ISSUES

2.1. ISTAT

Since November 2011, ISTAT has undergone major functional re-organisation; at present, environmental statistical information essentially refers to two departments. The Environmental Statistics Service was established within the Department for Social and Environmental Statistics (Division on Socio-demographic and Environmental Statistics). This service is organised into the following three units:

1. Urban Environment and Sustainable Development: its aim is to organise an environmental observatory for cities via a specific survey. Another project of this unit concerns landscape and land consumption, using specific information available at ISTAT, including the contents of the censuses carried out in 2001 and 2011;
2. Water Resources and Climate: its activities are currently focused on the ISTAT Survey on Water and developing Climate Change Statistics;
3. Families, Environment and Energy: this unit collects data on households' energy consumption and is involved with the well-established Multiscope Survey with regards to the relationships between populations and the environment.

Within the Department for National Accounts and Economic Statistics (Division on National Accounts), the Service on Environmental Accounts and Satellite Accounts System has been established. The interested reader may refer to UN et al. (2003) and UN (2000) (see also `http://unstats.un.org/unsd/envaccounting/ceea/`) for a review on the environmental accounting system, as well as to EU (2011). This service is organised into the following sections: Agriculture Economic Accounts, Environment-related Monetary Transaction Accounts, Balance of Material Flows, Environmental Accounts (Namea-type) and Human and Physical Capital Satellite Accounts. Census geographical databases are partially maintained by the following different sections: the Department on Census, Statistical and Administrative Archives (DICA), the Department for Integration, Quality and Development of Research Networks (DIQR). ISTAT participates in various initiatives coordinated by Eurostat and the OECD (see

http://www.oecd.org/). ISTAT has participated in the process of defining the System of Environmental-Economic Accounting (SEEA) framework. SEEA systems have been defined to support actions from the active debate on sustainable development. Air emissions accounts are one of the three main modules currently covered by ISTAT along with modules for material flow accounts and environmental taxes by economic activity. Additional accounts are currently under development.

Since the European Statistical System Committee (ESSC) adopted the final report of the "Sponsorship Group on Measuring Progress, Wellbeing and Sustainable development", ISTAT has collaborated with the National Council on Economy and Labour (CNEL) on the BES project (Fair and Sustainable Wellbeing). In this regard, Italy, through the role played by ISTAT, can be considered a leading country in comparison to other countries in the European Union. Three domains of the project report information on environmental topics: the Environment domain, the Landscape and cultural heritage domain and the Quality of services. For further information, see ISTAT (2013a).

From 2010, the UNSC (United Nations Statistical Commission) revised the FDES (Framework for the Development of Environment Statistics), and ISTAT participated to the revision. The framework identifies a core set of environment statistics in which ecosystems and natural capital are the key elements to organise a reliable system of environmental statistics. According to the FDES, environmental statistics are organised into six components to describe the state of the environment, its changes and its interaction with human activities. The new topics provide a modern approach to the analysis of environmental issues, including water and soil issues; this approach is quite similar to the DPSIR framework adopted by the EEA, see UNSC (2013) and, consequently, by ISPRA.

2.2. ISPRA

ISPRA activities generally focus on the country's needs to monitor the status and dynamics of the environment in response to the directives of the European Union Commission. Due to the environmental specialisation of the Institute, we mention that according to Annex 2 of the Legislative Decree 13/2007, only the following Departments are closely linked to the themes of water and soil:

1. Department of Soil: its activities entail soil protection according to organisational and functional perspectives;
2. Department of Environment State and Environmental Metrology: its activities focus on thematic issues (environmental pollution, waste, etc.) as well as inter-thematic issues (e.g., environmental assessment, management of the SINAnet network (see http://www.sinanet.isprambiente.it/it), INSPIRE, European Topic Centre on Inland, Coastal and Marine waters (EIONET) National Contact Point and environmental reporting);
3. Department for Inland and Marine Water: it focuses on the protection, use and management of inland, coastal and marine waters, supporting the country with respect to duties established by international laws, mimicking the activities of EIONET;

4. Department for Nature Conservation: it focuses on the conservation of nature and biodiversity and the production of geographical maps and surveys to evaluate the conservation status of natural elements in the national area.

ISPRA is the national focal point of the EEA. Several organisations within the European Union, such as Eurostat, EEA, OECD (Working Party on Environmental Information in support of the Environmental Performance Review), JRC (Joint Research Commission, data centre for soil and forests) and EIONET, come into contact with ISPRA about environmental issues. There is a memorandum of understanding between Eurostat, OECD, JRC and EEA with regard to environmental monitoring and reporting; however, the situation is continuously changing, even if the hierarchy is clear with the European Statistical System at the top.

EEA, in particular, examines 28 topics by monitoring networks established at the national level and maintained by national reference centres. In Italy, all the reference centres refer to ISPRA. The environmental information collected by ISPRA comes mainly from monitoring networks organised on a regional basis. Such networks cover, at least potentially, the whole country; however, the system does not have the standard characteristics of efficient collection and information release that are usually requested by Official Statistics producers, because it is designed to fulfil regulatory constraints. ISPRA activities use administrative and statistical data; ISPRA's mission is to provide assistance to the national government in responding to the demands of environmental information from the EU, national and local authorities and citizens. Therefore, it tends to organise the collection of information according to definitions established at the EU level. This specialisation may not lead to the spending of resources to build an overall and "representative" data collection system. Rather, collection procedures may be guided by environmental pressures, in particular by the tradition of environmental monitoring based on models that describe the environment in terms of the Determinants-Pressures-State-Impacts-Responses (DPSIR) framework, (Rijksinstituut voor Volksgezondheid en Milieu, RIVM 1995; Pierce, 1998; EEA, 1999).

The collection of information on the environment according to this model is suitable for policy purposes (use of sets of indicators ranked according to their role within the model) but is questionable when the statistical information on the state of the environment has to be produced for final users. This aspect reinforces the difference between genuine statistical data and data collected through monitoring activities required to the EU member states without the purpose of providing a statistical "survey".

2.3. The INSPIRE directive

INSPIRE (INfrastructure for Spatial InfoRmation in the European community) Directive 2007/2/EC aims at defining requirements and standards for an information infrastructure to support environmental policies. This directive will contribute, with other directives, to the implementation of the SEIS (Shared Environmental Information System). This system is designed to simplify the collection, exchange, use and analysis of environmental data, making the process more efficient. INSPIRE does not involve the collection of new data but rather standardises the use of data that have already been collected but not harmonised. According to the directive, the member states (in Italy through Legislative Decree 32/2010) identify a responsible structure (in Italy the

Ministry for the Environment, Land and Sea, IMELS) and a coordinating unit (ISPRA). The Italian Government proposed the National Council for Spatial and Environmental Information (CNITA), which has not been yet established. In general, the major difficulties preventing the full implementation of the directive depend on responsibility fragmentation and non-completion of the required legislative steps. Three operative structures are involved: the National Geoportal (GN), the National Environmental Information System (SINA, maintained by ISPRA) and the National Repository of Spatial Data (RNDT). The responsibility of data collection is usually owned by public agencies, with an example being the Agency for the Territory, which maintains the national land register.

The INSPIRE Directive covers 34 topics and includes services (discovery, view, download, transformation, invoke), elementary data and metadata. The starting points are the metadata in the RNDT. Art. 13 of the EU Regulation 1089/2010, covering the interoperability of data and services related to data, identified some metadata in addition to the set of metadata defined by the EU Regulation 1205/2008 applicable to all categories referred to in Annexes I, II and III of the INSPIRE Directive. Further, additional (optional) metadata may be identified corresponding to specific aspects of the topics of interest. Although the conformity of spatial metadata and services should refer to EU Regulation 1205/2008 only, we remark that the core of metadata in the RNDT includes all mandatory metadata plus several optional others. The link between the metadata provided by the RNDT, the metadata defined by EU Regulation No. 1089/2010 and the optional metadata defined thus far is reported in table 2 of the RNDT guide. The interested reader is referred to `http://www.rndt.gov.it/RNDT/home/index.php?option=com_content&view=article&id=53&Itemid=221` for details.

With regards to the monitoring actions defined by INSPIRE, only the data mentioned in ANNEXES I and II seem to be fully available at present. An estimate of the time needed to complete data availability is difficult; we may guess that completion could be expected by the end of 2015, whereas full conformity with the implementing rules is ensured within seven years since their adoption (2010 for ANNEX I and 2013 for ANNEXES II and III). The data specifications for each theme are proposed by thematic working groups.

The innovation of INSPIRE lies in the standardisation of formats and the collection of data coming from different administrations. In the future, to provide a rough example, it will permit the overlapping of building and landscape plans within a geographical/environmental information system. The INSPIRE Directive is crucial because it introduces, for the first time, a standard for the geographic representation of indicators or raw data; the periodicity and the coverage standards still need to be completely defined and the time needed for full harmonisation ought to extend to the end of the decade.

Overall, the adoption of the INSPIRE Directive will substantially change the release of environmental statistical information. However, the question remains whether the directive will comply with the code of practice of European Official Statistics Institutes. The directive, in fact, does not immediately produce data with the characteristics of official statistical data in terms of quality, geographic coverage and temporal representativeness, see Bodin (1999) for a review of the topic. The most reliable statistical information is in fact contained in the geographical databases that are not directly considered, but ISTAT and ISPRA are jointly examining how to manage this issue.

With regards to water, EU Directive 2000/60/EC is very broad and plays the role of

a framework directive among several other satellite directives, most of which are defined independently of one another. ISPRA is currently implementing a strategy for data on marine water using high-quality and high-quantity mapping following the INSPIRE Directive and focusing on the standards and characteristics of access and use of information that are not expected to vary in future years.

As regards soil, consider for example the resident population, which has never been released in greed format, i.e., superimposing cells of pre-determined size to an administrative territory. Information on land use will be better defined to comply with this new directive. At present, there is still confusion between the concepts of land cover, land use and land consumption. These concepts correspond to very different meanings. The definitions, which are rarely provided together with published data, should be further refined. In this regard, which is crucial especially for soil, the INSPIRE Directive will provide a valuable contribution to the development and harmonisation of standards, in terms of the collection and the production of basic data, the calculation of synthetic indicators and the ways of releasing information, see also ESPON (2012).

3. THE QUALITY OF COLLECTION AND RELEASE OF ENVIRONMENTAL DATA

The definition of the statistical unit and main features of a sampling design is notably important for data production. They are basic components of the statistical quality of the data collection process. Due to the characteristics of environmental data and the specificity of the involved agencies, they play an even more significant role in this type of data.

First, the concept of complete data is essential. This notion is expressed by the definition of the reference geographical units used to collect information as well as by a statement on the capacity to capture local details and provide representative pictures at different administrative levels. The consistency of data recorded at different levels of administrative or geographical aggregation is a goal yet to be achieved, even if the harmonisation of large-scale sources, which is a major declared aim, represents an appropriate action to favour comparability at the subnational level. Local initiatives are not uncommon. They usually move from acknowledging the inadequacy of large-scale data sources and long-standing traditions of producing good local information on specific topics. According to the time perspective, the concept of complete data entails the timeliness and continuity of information.

Second, under the perspective of releasing information, the precise identification of the addressee and the user is essential because even the same basic information can be conveyed to different users. This distinction is not always possible and, even when it occurs, it is not always clearly indicated by the media.

3.1. ISTAT

Until 2010, ISTAT published a volume of environmental statistics, the "Yearbook of Environmental Statistics", see ISTAT (2010) for the last release. Since that year, the

editorial policy of the Institute has changed and this publication is not currently available. Information will be released through flagship publications or short annual reports with specific sections dedicated to the environment.

The following ISTAT publications cover environment-related topics:

- "Noi Italia" (http://noi-italia.istat.it/): an interactive flagship publication organised by thematic areas, including the Environment (7 cards), Territory (5 cards), Energy (3 cards), Transport (8 cards) and Agriculture (5 cards). These publications contain dynamic charts and allow the downloading of data with spatial details for EU countries and regions. See ISTAT (2013b) for the last release;
- "Statistical Yearbook" (http://www3.istat.it/dati/catalogo/20111216_00/): a static publication (available in pdf format) where the reader finds chapters on the Environment and Territory, Constructions and Transport and Telecommunications; census and tables can be downloaded. See ISTAT (2012a) for the last release;
- "Italia in cifre" (http://www.istat.it/it/archivio/30344), see ISTAT (2012b): a static publication (available in pdf format) organised in sectors, with information on Territory, the Environment and Transport;
- "Annual Report" (http://www.istat.it/it/files/2012/05/Rapporto_annuale_ 2012.pdf): the last report was released on May, 2012. Chapter 4 is dedicated to "Inequality, Fairness and Services to Citizens" and contains sections on water, waste, public transport and land consumption. The publication is available in a static pdf format, from which summary tables, "core" indicators and a selection of graphics can be downloaded.

In addition to the static publications, ISTAT provides online press releases for thematic areas:

- Statistics Report – results from yearly surveys covering social phenomena, demographic and environmental themes (see, e.g., Urban environment indicators (http://www.istat.it/it/archivio/67990) and ISTAT, Statistiche ambientali (AMB), Indicatori ambientali urbani, Statistiche in breve (2000-2011); online since July 2012;
- Statistics Focus – concerns thematic insights, where data drawn from different sources may be linked; see, for instance, the report "World Water Day: Istat statistics" (http://www.istat.it/it/archivio/57514), where a summary on the supply of water for drinking and household consumption is provided;
- "i.Stat" – data warehouse broadcasting organised according to themes (environment and energy, agriculture) and territorial levels.

The metadata from ISTAT surveys are exhaustively available through the system SIQUAL (Information system on quality of statistical production processes), where information on survey questionnaires are reported in the section "Information on respondents". At present, the data warehouse I.Stat is not fully powered because the migration of data from several, sector-specific data sources is in some cases slow because

it requires standardisation of definitions, contents, procedures for access and release. Data from surveys are commonly available in micro-data files (sample collections of elementary data from ISTAT surveys), standard files, search files and ADELE (Laboratorio per l'Analisi dei Dati ELEmentari, Data Research Centre, DRC), which can be accessed by scholars for statistical analyses of microdata owned by the institute according to the standard confidentiality laws.

3.2. ISPRA

The Environmental Data Yearbook (the use of the term data, rather than statistics, does have a clear meaning) is the main publication and is released at unequal intervals. The latest version, see ISPRA (2012) covers data up to 2010, reporting indicators updated from 2000 to 2009-10. Section C of Chapter III of the yearbook reports the indicators for environmental conditions organised according to the quality of environmental resources (S) and the pressure factors (P), which tend to influence such quality by producing impacts (I) on ecosystems. The section is divided into ten chapters (6-15) linked to the SINAnet (Network of the National Environmental information System) thematic areas: atmosphere, biosphere, hydrosphere, geosphere, waste, ionising radiation, non-ionising radiation, noise, natural hazards and anthropogenic risks. The Yearbook may be used as a relevant source of information on the state of the environment, regardless of the model used to describe the action/reaction between humans and ecosystems. For each indicator, it provides the following information: SINAnet theme, indicator name, role in the DPSIR model, frequency of updating, information regarding quality (based on a score that summarises its strength/weakness, reliability, relevance, comparability in time and space), spatial coverage, temporal coverage, the status and trends (via a qualitative description). The yearbook contains a well-written, although synthetic, guide that clearly explains how the publication should be gone through. The perceived quality and the overall structure of the publication are different from those of similar ISTAT publications. Considerable attention is devoted to the definition of the elementary data used to build the indicators, to continuous information updating and to the availability, through an ad hoc website, (`http://annuario.isprambiente.it/`) of a huge amount of environmental data.

4. STATISTICAL INFORMATION ON WATER

As previously mentioned, we will discuss two environmental themes, water and soil, to provide a direct example of the remarkable development the statistical information on environmental issues has experienced over the last few years. Despite this increasing interest, the quality of available information is quite scattered, in response to external pressures (in terms of request for information), which can be agency specific. For both themes, we found areas of substantial interest for local and national communities that are not yet covered by the "official" statistics.

The "water" resource is studied as a natural resource using the standard subdivision in groundwater and surface waters. The latter are categorised according to the type of water resources (rivers, lakes and coastal marine waters), with a particular emphasis on

the state and dynamics of bathing waters, regulated by specific directives of the European Union and the National Government. Additionally, the impact of anthropogenic factors, such as those linked to irrigation, the use of water for urban/drinking purposes and wastewater, must be considered.

4.1. ISTAT surveys on water

The data released by ISTAT, refer to different levels of geographical and administrative detail. The major ISTAT project within the National Statistical Programme (PSN) is the Census of Civil Use Water. Since 1951, ISTAT has periodically collected information on water resources for domestic use through a specific census describing the state of urban water services in Italy. The focus is on (*i*) drawn and circulating water, (*ii*) water supply systems, (*iii*) sewerage and (*iv*) wastewater treatment installations.

The survey chronology (1951, 1963, 1975, 1987, 1993, 1999, 2005 and 2008) provides a basis for developing an information framework that has been progressively updated by following both the European directives on water and the increasing call for information from public institutions and private stakeholders.

The respondents, which are identified during preliminary surveys, are water management companies (at present, 3,351 subjects in total, out of which there are 2,800 municipalities) that are interviewed for each type of provided service.

After the 1999 edition, both the contents and the production process were deeply renewed. The last edition of the census was carried out in 2008. The next census event is in course and concerns the year 2012. The new survey is arranged through web solutions, with a dedicated website to respondents offering technical assistance and personalised spreadsheets for easier and faster reply.

Moreover, the engagement of ISTAT in Water Statistics became more intense in 2011 with the beginning of a project aimed at calculating some indicators required by the OECD-Eurostat joint questionnaire on Inland Water, covering fresh water resources, water drawn by use, water use by supply category and wastewater treatment. This research project has several objectives. The first is the development of high-standard tools for data collection to produce well-timed and reliable results and ensure the continuity of indicators production. An exhaustive and detailed reference frame for water in the whole country, describing the uses of the different production sectors (agriculture, industry, services), the local management and the impact of environmental processes (for example, the climate change) are further fundamental targets. Data and indicators should be provided for all available years, likely since 2000 for most indicators, both at national and sub-national levels. The level of spatial aggregation should be Regions (NUTS 2) and River Basin Dis-tricts (recently established under the European Framework Directive 2000/60/EC). Intense cooperation with Basin Authorities is going to be developed to this aim.

Additional water data, especially about use in urban areas, are available through I.Stat, where, for example, water flows and drinking water availability are recorded by region (as mentioned in the ISTAT 2012 Annual Report). Other data can be derived from the "Multiscope Survey" (Aspects of daily life of households). Moreover, data have been collected for the province heads on different themes since 2000, including water from the Urban Environment Survey.

4.2. ISPRA surveys on water

ISPRA is currently working towards improving SINTAI – the National Information System for the Protection of Italian Waters, which includes data collected to comply with environmental reporting and monitoring purposes due to its role of the national node in the Water Information System for Europe (WISE). Information concerning the state of water bodies available through SINTAI is to be collected at least every six years, although regions may collect information yearly, choosing which specific indicator needs to be monitored more accurately. As regards the marine strategy, data on rainfalls, flow rates and temperatures are available, along with the initiatives connected to SIVIRI (Sistema Informativo Vigilanza Risorse Idriche, i.e., Informative System on Water Resources Monitoring) and EIONET. SIVIRI is very closely linked to UWWTD (Urban Waste Water Treatment Directive), which addresses wastewater treatment installations and actions to reduce incoming loads. With regards to wastewater, reports have been produced for 2007, 2009 and 2011. These reports describe the status of sewage treatment installations in Italy for municipal non-industrial activities. The overall information drawn from these data helps in the environmental assessment of the state of purification. The EU recommends the indicator "wastewater volume per capita" in terms of population equivalents. The indicator can also be calculated in terms of permanent residents. The topic has been discussed in the international fora and only two states did not agree with the standardisation with respect to the resident population.

The sample design adopted to collect the data described in the publications released by ISPRA can be identified through the "indicator sheet". In particular, for surveys on water, information can be drawn from the yearbook or through guidelines and manuals, as well as by making explicit reference to INSPIRE Directive 2000/60/EC.

With regards to the hydrosphere, the Environmental Statistical Yearbook clusters water bodies into disjoint categories: rivers and streams; lakes and reservoirs; transitional waters, including areas from river outfalls; lakes; coastal ponds with interaction between fresh and salt water; marine waters and groundwater. The available water resources, namely inland surface waters, coastal marine waters and groundwater, are described by a set of indicators covering six environmental themes: the quality of the water bodies, water resources and sustainable use, pollution of water resources, the physical state of the sea and the coasts in the lagoon of Venice.

Each theme is described through a set of indicators, which are classified according to the characteristics listed above. This structure aims at using the indicators for comparison, checking the current status and the observed trends. Several of the laws established to protect water at both national and international levels are mentioned in the relevant chapters, although the general framework is not completely clear.

In this context, the reference population is related to the system of water bodies. The law regulations introduced to protect water resources are based on such survey units, which may be quite different in definition and meaning from those typical of statistical surveys. The homogeneous aggregate defined as the basic unit is the "water body", corresponding to a set of water resources that must be jointly analysed to be protected. The immediate consequence is that the same water stream may refer to different water bodies. However, starting from the Framework Directive, which requires a report every six years for each water body based on an accurate monitoring set of activities, algorithms have been developed from monitoring to classification to obtain quality status assessment. Monitoring occurs within EIONET and is in turn headed by EEA.

5. STATISTICAL INFORMATION ON SOIL

International information on soil use may be derived from several, different sources. The CORINE (Coordination of Information on the Environment) programme is supplied by EEA, whereas the Land use/cover area frame survey (LUCAS) has been originally developed by Eurostat to estimate wheat production in the EU. After a pilot phase (from 2000 to 2007), LUCAS is now in full development. The two programmes are motivated by different demands and produce different information. They are somehow the consequence of the lack of initial standardisation of the duties and aims of agencies providing environmental information with the potential overlapping of available information and resources.

Soil consumption can be defined as the set of soil statuses ranging from natural characteristics to artificial conditions, among which soil sealing constitutes the last stage. Soil sealing, according to the 2006 "Directive of the European Parliament and of the Council establishing a framework for the protection of soil and amending Directive 2004/35/EC", is defined as the permanent covering of a soil surface with an impermeable material. Soil sealing is considered an almost irreversible phenomenon.

Urban sprawl may be defined as "the physical pattern of low-density expansion of large urban areas under market conditions into the surrounding agricultural areas". Sprawl pre-exists to the main directions of urban growth and implies the insufficient planning and control of territorial partitions. Development is inhomogeneous and sparse, tending toward discontinuity because it occurs in a subset of areas, leaving some agricultural areas landlocked. The expression, therefore, describes the uncontrolled expansion of urban areas and contrasts the idea of compactness of the urban shape.

Landscape fragmentation refers to the spreading of continuous tracts of ecosystems, creating barriers to migration and dispersion of living organisms and reducing the extension of homogeneous areas. Fragmentation may be due to human activities (as roads or dams) or to natural processes that can be only partially controlled by man.

5.1. ISPRA survey on soil

ISPRA maintains a strong tradition of statistical information on soil, even if regulations and common definitions concerning soil are not available. In the EU, a proposal for a directive is under study, but it has been blocked since 2006. Consequently, the construction of environmental indicators suffers from this lack of regulation, producing a lack of uniformity between the indicators that are used and the national monitoring networks. For this reason, the harmonisation of available data is a complex task; official statistics may play a driving force role in this context by suggesting or supporting the introduction of specific regulations to cover these information needs.

Even if a national or supranational reference frame does not exist or is only partial, regional studies have been developed, where data have been collected using different approaches and, therefore, cannot be compared. Under the spirit of the INSPIRE Directive, ISPRA should collaborate with regions to harmonise the information at its disposal, the procedures used for data collection and the standards for the production and release of indicators. For instance, many difficulties exist concerning the estimation of water erosion, which is computed according to deterministic models. Differences in the

quality of regional pedological maps may induce strong differences in the corresponding estimates.

Subnational data collection provides very interesting reliable local information. A typical example is data on quarries: because the mining sector is regulated by regions, the techniques used for data collection may be quite different, but extracted quantities ought to be always reported because they represent a basic input for environmental-economic accounting. The monitoring activities usually carried out by ISPRA directly answer to specific legislation requirements that may be inadequate. For quarries (second category minerals), every year, ISPRA proposes a questionnaire to regions (agencies for mining activities), but information regarding mines (first category minerals) still refers to 2006 as derived by the Census on the topic (art. 22 of the Law 179/2002 requested the Census of the abandoned mines to the Ministry of Environment and Protection of Land and Sea). Moreover, Law 464/84 requests the transmission of a series of due documents, including use and stratigraphies, to the regional Geological Survey for wells and drills deeper than 30 meters. For an extra European view, see the Geological Survey of Canada (http://www.nrcan.gc.ca/earth-sciences/home).

As a synthesis, regions hold data on soil, whereas the role of ISPRA is variable and is a function of the indicator at hand. Furthering the examples, as regards water erosion and the CO content of soil, information comes from regions that, through a common exchange format, provide "revised" final data to ISPRA. For these indicators, collaboration is possible between regions and such projects as the Agricultural and Meteorological Sicilian Information Service (SIAS) to reach a homogeneous national coverage. Similar considerations can be made for desertification. In this case, different cartographies are available (since 1999, 3-4 waves were registered) that produce similar results, whereas the databases, i.e., the rough data, are different. A set of regional cartographies covering principally the south of Italy is the result of projects or agreements between regions and the former National Committee to Combat Drought and Desertification. This coverage is usually national, but several regional cartographies are available for desertification and CO content, which, even if not totally comparable, are employed to construct specific indicators.

The opportunity of web access to data on the soil is related to interventions funded according to law 67/1998. Via the Rendis (Repertorio Nazionale degli interventi per la Difesa del Suolo) web system http://www.rendis.isprambiente.it/rendisweb/, access to information related to single interventions for soil protection is possible. Access is possible only to users working for institutions and Public Agencies that are active in planning and/or control actions for soil protection. ISPRA has access to the following databases:

1. for wells and drillings deeper than 30 meters from ground level (law 464/84): geosites data bank (with public access); CARG (Geological CARtography) project data bank, scale 1:50,000. Because a specific regulation does not exist, other "official" sources on this topic do not exist. However, other databases on soil are available: in particular, the Florence Research Centre for Agrobiology and Pedology (CA-ABP), formerly known as Institute for the Study and Soil Conservation (ISSDS), manages a database of Italian soils;

2. the yearbook published by ISPRA, in the Geosphere system, addresses soil in a strict sense, i.e., the upper part of the earth crust, the underground, i.e., the part of the crust that goes from the ground level to some hundred-thousand meters deep and the

territory intended as the surface on which human activities occur. The available databases are as follows:

2.1 CORINE Land Cover (Years 1990, 2000, 2006, 2012 – still under development; scale 1:100,000, national coverage);
2.2 GMES Urban Atlas (Year 2006, under updating – source EEA; scale 1:10,000, principal urban areas coverage);
2.3 GMES initial Operations (GIO) Land Monitoring HR layers (Years 2006, 2009, 2012 – still under development; resolution 20 mts), themes: imperviousness, tree cover density, forest type, grassland, wetland, permanent water bodies;
2.4 national network of soil consumption (Years 1946-1960, 1988-1989, 1994-1997, 1998-2000, 2005-2007, 2008-2012) sample survey. National, sub-national NUTS 1 level, regional level, NUTS 2 coverage;
2.5 urban networks of soil consumption monitoring (Years 1946 to 2012, different according to various urban areas; Source ISPRA-ARPA-APPA); sample survey: 43 municipalities covered.

5.2. ISTAT survey on soil

Statistical information needs to efficiently intersect with geographical referencing for data collection and construction and the release of information. ISTAT is aware of this point and is developing a special interest towards the topic of soil. For instance, the President of ISTAT, in a hearing in January 2012 at the XII Commission on "Territory and Environment" of the Senate of the Republic, delivered a statistical annex with an abundance of information on soil use. Several of the information was fragmentary and a number came from censuses, except for building activities and estimates of national accounts regarding surfaces. This insight regarded soil use (better, soil consumption) with special attention on the anthropisation processes and destinations of the soil itself, rather than biodiversity preservation or the assessment of the status of surface pollution. Further information concerning this issue might be available from publications concerning the impacts, or pressures, of zootechnics.

ISTAT already possesses information that might be exploited with stronger synergy than the current data. To provide an example, the cartographic information coming from the census might be used in a more intensive way; similarly, collaborations with regions in the north of the country might be integrated with official statistics production. Soil has not been acknowledged as a separate environmental theme, at least in the currently available publications. Rather, it has been treated under several themes that have been dealt with separately, such as wildlife preservation, ionising radiation, seismicity, agriculture (with hunting and forestry), energy consumption and controls for soil pollution. In the chapter of the yearbook that addresses wildlife preservation, the reader can find information on forest surfaces, game-hunting companies and special protected areas. Information on Usable Agricultural Areas stratified by use (e.g., arable), tillage, succession crops and reuse practices are also available. Some interesting information concerning plant protection products, the active principles they contain, fertilisers and nutrients over a ten-year period is at least available at an aggregated national level. Information about nutrients comes from a sample survey that is not described in detail, conducted on approximately 1500 farms; the survey focuses directly on the products that

influence the ecosystem rather that their sale. The overview that can be obtained from this information does not represent statistical information about the use of soil or corresponding pollution levels but is rather the synthesis of a set of characteristics of farms.

Most of the above topics might be included under the head of the use and preservation of soil but are reported with different aims, e. g. independently from seismicity, which, in itself, is considered a geo-morphological characteristic of territories. Indeed, the measurement of seismic events is entrusted to the National Institute of Geophysics and Volcanology via the National Seismic Network (see: http://www.ingv.it/banche-dati/). These events are monitored by other two networks: the National Accelerometric Network and the Seismic Observatory of Structures, within the Civil Protection Department, which aims to forecast, in real time, the potential consequences that may derive from such events. Some interesting international comparisons have been published on this topic; they cover a decade (1999-2009) and the regional NUTS2 zones are classified according to their seismic risk. From statistics concerning industrial activities, one may obtain information about the companies' investments in relation to the environment, classified according to the number of employees and the region of the firm (installation) and about the distribution of firms at risk of accidents, which, unfortunately, has no specifications regarding whether the risk concerns mankind, the environment or something else. Further information concerning the use of soil, defined under an economic perspective, may be drawn from statistical data on transportation and tourism and investigations made by the police at some firms at risk of accidents. However, soil and territory are becoming more and more important topics for ISTAT and we are facing a change from a viewpoint of territory as essentially a support to geo-referencing for indicators of economic and social activity to a perspective in which soil, its characteristics and its destination, together with the issues of soil sealing and fragmentation, assume their own role, without being related to geographical positions. In the future, ISTAT is going to work towards the analysis and production of statistical information on the consumption of soil.

As far as Urban Environment Statistics are concerned, as already mentioned, data have been collected since 2000 for 116 municipalities heads of provinces. This environmental survey aims to produce basic statistics and indicators on 8 main themes: air, energy, green areas, noise, transport, waste, water and population and territory eco-management; it looks at the pressures put on the urban environment and measure the responses of the State. The idea is also to satisfy the new demand information about "smart cities", in this sense, an innovative product has been introduced. For the new edition of this survey, ISTAT worked with Legambiente to find solutions to limit burden responses. ISTAT is working in the Eurostat Task Force, which follows the LUCAS 2012 project and also on an Eurostat Grant together with ISPRA and other institutions on the harmonisation of soil information.

6. CONCLUSIONS

Both ISTAT and ISPRA wish to find synergies and fix official general agreements, possibly by focusing on yearly joint programmes on environmental data and information. The first topics to face are urbanisation and soil. ISTAT made a proposal,

which is shared by ISPRA, for the creation of a network of environmental statistics through joint agreements between the institutions participating at SISTAN. These agreements may be extended to non-institutional organisations, as well, see for instance `http://www.gruppo183.org`. For instance, as regards Urban Environment, ISTAT is performing a survey that would greatly benefit from the expertise of Legambiente.

To define a set of indicators to measure the relationships between population wellbeing and the Environment, landscape and cultural heritage endowment, three survey themes, namely, urban, rural and natural themes, are on the fore.

For the urban survey theme, the elementary units consist of the areas included in towns, villages and production areas as mapped in the geographical databases produced by ISTAT for population censuses. For the rural theme, the chosen elementary units are agricultural regions, where territories are considered according to "phases" corresponding to three different stages of rural space evolution. The first is the central phase, corresponding to stable or active agricultural areas. For the two other phases of transition, one is defined towards urbanisation, or areas of urban sprawl (i.e., areas with low density and diffused forms of construction) and the other is defined towards savage/natural situations, or areas where overgrown agricultural areas tending toward re-naturisation can be observed.

The ISPRA team is highly skilled in information sciences and is well-suited to harmonise new data collection procedures, measurement techniques and information about data release. ISPRA information repositories might receive further added value should they be compared in time and space and associated with procedures to assess data quality and error measurement. For these datasets, some steps regarding statistical data collection and processing might be improved. For instance, the introduction of the concept of a "water body" and the classification made by experts' evaluations are highly similar to non-stochastic quality control procedures, which can be useful for monitoring systems suitable for guiding policies but are less efficient for information reporting and diffusion. The release of information on this topic is a complex task and has to comply with the ISPRA mission, which is not the collection and publication of statistical data but rather the production of environmental indicators that are mainly suggested by supranational law dispositions.

The two possible roads for the future are the joint production of environmental statistical information by different institutions or, as an alternative, the explicit sharing of tasks, in particular if all of the institutions belong to SISTAN. The choice of rules for daily tasks should be easier, at least in principle, when new projects are developed. On the contrary, the definitions of roles and tasks would be more difficult when proposals of collaboration regard data collection and production for themes that have been, in the past, dealt with by more than one institution and therefore appear to be similar or substantially overlapping. In this case, discussions of tasks and responsibilities would be difficult and a thorough exploration phase of the agreements of the involved institutions would be necessary to arrive at the best sharing of any decision.

In this paper, both the periodical and one-shot surveys on environmental topics related to water and soil performed in Italy by ISTAT and ISPRA have been described. We have also sketched the evolution of data release, from the traditional ISPRA "Environmental Data Yearbook" and ISTAT "Environmental Statistics" publications to easier and more time-efficient formats. The new releases will improve timeliness and be more directly connected to the data collection mode and survey designs, making such information directly available to the reader. The web already provides access to

elementary/aggregated data.

ACKNOWLEDGEMENTS

This paper develops the contents of the final relationship of the Committee on "Verifica dello stato dell'informazione statistica del Sistan sull'ambiente", nominated by the COGIS (Commissione per la Garanzia dell'informazione Statistica) in November 2011. The authors thank the President of the COGIS, Achille Chiappetti and the members Pierpaolo D'Urso and Lucia Vitali for their continuous encouragement to perform the task. The authors wish to thank the Committee members Marco Pirra and Alessandro Sterpa for their useful exchange of ideas. We wish to thank also the ISTAT and ISPRA groups, coordinated by Angela Ferruzza and Maria Concetta Giunta, for the important discussions, along with two anonymous referees.

REFERENCES

J. L. BODIN (1999). *Etat des réflexions sur les principes fondamentaux de la statistique publique*, Série Etudes n. 2, AFRISTAT, Paris, http://www.afristat.org/contenu/pdf/rsc/reflexions.pdf.

ENEA (2013). *Rapporto Annuale Efficienza Energetica 2011*, downloadable at the website www.enea.it/ following: Produzione Scientifica, Edizioni ENEA.

ESPON (2012). European Spatial Observation Network, Natural and technological hazards and risks in European regions. Project overview http://www.espon.eu/main/Menu_Projects/.

EUROPEAN ENVIRONMENT AGENCY (EEA) (1999). *State and pressure of the marine and coastal Mediterranean environment*, Environmental Assessment Series. European Environment Agency, Copehagen, Denmark.

EUROPEAN ENVIRONMENT AGENCY (EEA) (2010). Mapping the impacts of natural hazard and technological accidents in Europe, An overview of the last decade, Technical report n. 13/2010: http://www.eea.europa.eu/publications/mapping-the-impacts-of-natural.

EU (2011). Regulation No 691/2011 of the European Parliament and of the Council of 6 July 2011 on European environmental economic accounts, *Official Journal L 192, 22/07/2011 P. 0001 – 0016 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri =OJ:L:2011:192: 0001:01:EN:HTML.*

INSPIRE (2007). Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community.

ISPRA (2012). Annuario dei dati ambientali 2011: http://annuario.isprambiente.it/.

ISTAT (2010). Statistiche Ambientali: http://www3.istat.it/dai/catalogo/20091130_00 .

ISTAT (2012A). Annuario statistico: http://www3.istat.it/dati/catalogo/20121210_00/

ISTAT (2012B). Italia in cifre: http://www.istat.it/it/archivio/30344

ISTAT (2013A). *bes 2013, Il benessere equo e sostenibile in Italia*, downloadable at the website http://www.istat.it/it/files/2013/03/bes_2013.pdf.

ISTAT (2013B). Noi Italia: http://noi-italia.istat.it/.

LEGAMBIENTE E DIPARTIMENTO DELLA PROTEZIONE CIVILE (2011). ECOSISTEMA RISCHIO 1 Monitoraggio sulle attività delle amministrazioni comunali per la mitigazione del rischio idrogeologico, http://www.legambiente.it/sites/default/files/docs/dossier_ecosistemarischio2011.pdf.

M. PIERCE (1998). *Computer-based models in integrated environmental assessment.* European Environmental Agency. Technical Report, 1.

RIVM (1995). *A General Strategy for Integrated Environmental Assessment at the European Environmental Agency.* Bilthoven, The Netherlands: National Institute of Public Health and Environmental Protection (Rijksinstituut voor Volksgezondheid en Milieu).

UNITED NATIONS (2000). Integrated Environmental and Economic Accounting – An Operational Manual.

UNITED NATIONS, EUROPEAN COMMISSION, INTERNATIONAL MONETARY FOUND, WORLD BANK (2003). Integrated Environmental and Economic Accounting.

UNSC (2013). Framework for the Development of Environment Statistics (FDES) 2013.

SUMMARY

Official environmental statistical information in Italy

In this paper, we provide descriptions of the official statistical information sources regarding the environment with a focus on soil and water. The discussion focuses on two major contributors of official statistical information in the field, ISTAT and ISPRA, describing their internal structures and links to corresponding EU institutions. We further review their latest production of statistical information on soil and water and provide several suggestions for the potential development of the field.