PROLINE-CE

WORKPACKAGE T1, ACTIVITY T1.1

PEER REVIEW OF LAND USE AND WATER MANAGEMENT PRACTICES

D.T1.1.1 Country Reports About the Implementation of Sustainable Land Use in Drinking Water Recharge Areas

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ITALY

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1. Introduction

The Italian territory is characterized by a large variability as in terms of climate conditions and geomorphological features as in terms of prevalent land use; such condition entails that water demand, availability and treatment are deeply varying. In the Report, an attempt to account for such differences is carried out firstly, referring to the abundant and comprehensive legislative and regulatory production, currently available for Italy, that is briefly illustrated by considering also Regional laws. After, Corine Land Cover (CLC) datasets provide an overview about the current land use activities and their distribution within the Country. Such data reveal how the main part of Italian territory is covered by agriculture areas (about 52%) employing more than 1.5M of workers while urban settlements do not exceed 4% of entire surface with about 4M of people working in Manufacture sector. Then, for the main identified land use and activities are reported general details and, in special way, how they use and manage water resources from uptake to water treatment. In this regard, lots data are made available by National Institute of Statistics (ISTAT) and Italian National Institute for Environmental Protection and Research (ISPRA). A synthetic overview about the main issues related to water management is then returned by using DPSIR approach for the main sectors previously considered. SWOT analysis resume the main findings of analysis, stresses the principal gaps and the most relevant opportunities in future activities related to water management. Finally, the progresses in implementation of the WFD programmes of measures are summarised through Key Types of Measures (KTMs) recognized as relevant for PROLINE-CE Project.

2. Water supply resources, protection and management policy on national and regional level

In Italy water policies are based on the general principle of subsidiarity, fundamental to the functioning of the European Union, as well as on the principles that all waters are public and that water itself is a good of general interest. Regional and national policies on water are managed through a multi layer governance system, where competences are distributed among different territorial and sectoral Institutions (Alberton, 2011). One of the first national law on water was the Royal Decree 1775/1933 "Single Text of legal provisions about waters and hydropower", according to which for the first time it was declared that all waters are public, including ground waters (Silvestri, 2007). The same Decree identifies the different categories of water users, considering big and small withdrawals and introducing the water users Registry. Successively the Law 129/1963 supplies the "General master plan of water works". River basin management level in Italy was first introduced by the Law 183/1989 "Norms for soil conservation", whereas the integrated water cycle, managed at the Optimal Territorial Unit level, was first regulated by the Law 36/1994 "Norms on water resources". The Legislative Decree 152/1999 brought "Provisions on water protection from pollution and adoption of European Directives on urban waste water treatment and water protection against pollution caused by nitrates from agricultural sources". Finally the Third Part of the Legislative Decree 152/2006 "Norms Concerning the Environment", commonly called "Single Environmental Text", brings the "Norms for soil conservation, combating desertification, water protection from pollution and water resources management". The Single Environmental Text contains, integrates and updates definitions, objectives, institutions, competences, rules and instruments previously given by different and disconnected legislation sources, among which the aforementioned L. 183/1989, L. 36/1994 and D.lgs. 152/1999. The Single Environmental Text regulates the Basin Plans, Water Management Plans and Water Protection Plans.

Flood management is regulated by the Third part of the Single Environmental Text, together with the Legislative Decree D.lgs. 49/2010 "Implementation of Directive 2007/60/CE on flood risks evaluation and management". They respectively regulate the Hydrogeological settlement Plans (PAI) and the Flood risk Management Plans (PGRA). Furthermore, competences, procedures and activities for civil protection against flood disasters are regulated by the Law L. 225/1992 concerning the "Institution of the national Service for Civil Protection", as subsequently amended and supplemented by the Low n.100/2012. Flood early warning objectives, organization and procedures are regulated by the Directives of the President of the Council of Ministers on 27.2.2004 and on 8.2.2013, concerning "Institution and operational guidelines for the organization and management of the national distributed early warning system on hydrogeological and hydraulic risk for civil protection".

Drought legislation is also included in the Third Part of the Single Environmental Text.

Finally it must be considered that in Italy all European Directives both concerning water protection, water management, floods and droughts has been adopted.

On 13 July 2016, a permanent network of "Observatories on water uses" has been established among all public and private stakeholders of national relevance.

Furthermore, data, statistical analysis and reports on water management are regularly published by several public and private organizations such as COVIRI, ISTAT, ANEA, UTILITALIA, IRSA, ANBI, ISPRA and the network of Permanent Observatories on water uses. Hydrological data are collected in Hydrological Yearbooks (AA.VV., La siccità in Italia; AA.VV. Un future per l'acqua in Italia).

2.1. Water management

- Which water resources (groundwater, surface water-lakes, reservoirs…) are used for water supply and in which rate?

In 1971-2000 (ISTAT), the mean annual precipitation was around 111000 Mm^3 on Northern Italy and around 241000 Mm^3 on Italy. The mean annual real evapotranspiration was respectively around 69000 Mm^3 and 155000 Mm^3. The difference between precipitation and evapotranspiration is the mean annual potentially available water resource, around 42000 Mm^3 for Northern Italy and 86000 Mm^3 for Italy. These are theoretical values and can be considered upper limits of available water resources.

At present, data on the water supply for the Italian territory are not homogeneous.

Drinking water supply data are the more detailed and complete (ISTAT, 2012, http://dati.istat.it/), and point out:

- for the entire territory of Italy, abstractions of: 3496 Mm3/year from springs, 4528 Mm3/year from ground water wells, 1427 Mm3/year from surface waters (of which 981 Mm3/year from lakes/reservoirs);
- for the north of Italy, abstractions of: 1132 Mm3/year from springs, 2063 Mm3/years from wells, 386 Mm3/year from surface waters (of which 146 Mm3/year from lakes/reservoirs).

Irrigation data are less complete. Water abstractions of surface water operated by irrigation consortia are evaluated be 20600 Mm3/year for north Italy (RBMPs of Po and Eastern Alps Districts); no data are available for the whole territory of Italy. Similarly, no complete data are available for ground waters abstractions for irrigation uses; partial data, from RBMPs and previous regional Water Protection Plans, show abstractions of 100 Mm3/year in Veneto/Friuli Venezia Giulia/Trentino Alto Adige, 380 Mm3/year in Piemonte and 230 Mm3/year in Emilia-Romagna. On basis of ISTAT data of water used at farm scale, it can be estimated an abstraction of ground waters of ~2200 Mm3/year in Italy and 810 Mm3/year in north Italy, and an abstractions of surface waters operate directly by farmers of 2400 Mm3/year and 1800 Mm3/year in north Italy.

Zootechnical uses are very low, and can be estimated be 300 Mm3/year for Italy and 200 Mm3/year for north Italy on basis of livestock numbers (ISTAT, 2010) and per capita water consumption standards for each type of livestock (from Water Balances updates in Emilia Romagna Region).

Industrial abstractions are about 2000 Mm3/year for north Italy (RBMPs of Po and Eastern Alps Districts). No complete data are available for Italy, about 3000 Mm3/year can be estimated on

basis of number of employees and water consumption standards for each type of productive activity.

Hydropower uses are not included. Also non included are abstractions related to internal navigation, environmental uses on canals, civic uses, etc.

Table 1. Water supply for the main type of use in Italy and north Italy (Emilia-Romagna, Piemonte, Lombardia, Veneto, Trentino Alto Adige, Friuli Venezia Giulia, Valle d'Aosta, Liguria) - Mm3/year

Type of use	Italy	North Italy
Drinking water:		
Ground waters	4528	2603
Surface waters and springs	4923	1518
Irrigation:		
Ground waters	~2200	~810
Surface waters (by Consortia)	No Data	~20600
Surface waters (by farmers)	~2400	~1800
Industry	~3000	~2000
Zootechnics	~300	~200

According to this Table for Northern Italy the drinking and irrigation water supply consists in 12% of groundwater resource and in 88% of surface water resource.

For which purpose is this water used?

Water supplied to customers (for both domestic and non domestic use) is evaluated be 5250 Mm3/year for Italy and 2600 Mm3/year for north Italy (ISTAT, 2012, http://dati.istat.it/).

Water required for irrigation of the crops is estimated (ISTAT, 2014, http://www.istat.it/it/files/2014/11/Utilizzo_risorsa_idrica.pdf) in 11,100 Mm3/year for the entire territory of Italy, and 8100 Mm3/year for north Italy. Main crop uses are rice (4400 Mm3/year used by farmers), mais (1750 Mm3/year used by farmers) and fodder crops (1350 Mm3/year used by farmers).

For animal husbandry and industry, abstractions reported in the previous paragraph differ very little to amounts used at farms and factory.

Table 2. Water used for the main type of purpose in Italy and North Italy Emilia-Romagna, Piemonte, Lombardia, Veneto, Trentino Alto Adige, Friuli Venezia Giulia, Valle d'Aosta, Liguria) - Mm3/year

Type of use	Italy	North Italy
Drinking water	5250	2600
Irrigation	11100	8100
Industry	~3000	~2000
Zootechnics	~300	~200

- Who controls and manages water policy?

In accordance to the national and EU legislation, water policies are structured in different levels of actions: "Ministry of Environment, Land and Sea" governs compliance with regulations and relates with the EU and coordinates activities of District authorities; District Authorities draw up the "River Basin Management Plan" (RBMP) that contains "high level" Program of measures (Key type of measure); in Italy (Dlgs 152/06) the Regional authorities prepare the "Water Protection plan" ("Piano di tutela") with the Program of measures at regional level.

- *Who control and manage drinking water policy?*

Ministry of Health, Regions, competent health offices.

- The legal and administrative organization of water policy?

National, regional and local administrations.

- The legal and administrative organization of drinking water policy?

National and regional administrations and competent health offices.

- Who manages and coordinates implementation of state policy in scope of water?

Ministry of the Environment, Land and Sea (Ministero dell'Ambiente e della Tutela del Territorio e del Mare - Direzione generale per la salvaguardia del territorio e delle acque) and River District authorities.

- Please provide a list of legislation related to water management, their protection and management of floods/droughts (land use legislation/polices, Water management legislation/policies, groundwater and surface water management plans and other legislation)

The L. 221/2015 modified the territorial domains of River basin districts: the territory of Emilia-Romagna belonging to "*Distretto Appennino settentrionale*" (Northern Apennine district) (nearly half of regional area) is transferred to "*Distretto del Fiume Po*" (river Po District). Current RBMPs, approved in early 2015, will remain in force until next update (at that time Po district will include almost all the territory of Emilia-Romagna Region).

Main national legislation:

D.Lgs. 152/2006 "*Norme in materia ambientale*" (known as Environmental Code).

D.Lgs 219/2010 "*Attuazione della direttiva 2008/105/CE relativa a standard di qualità ambientale nel settore della politica delle acque, recante modifica e successiva abrogazione delle direttive 82/176/CEE, 83/513/CEE, 84/156/CEE, 84/491/CEE, 86/280/CEE, nonché modifica della direttiva 2000/60/CE e recepimento della direttiva 2009/90/CE che stabilisce, conformemente alla direttiva 2000/60/CE, specifiche tecniche*

per l'analisi chimica e il monitoraggio dello stato delle acque". (Regulating water status analyses and monitoring).

D.Lgs. 31/2001 "Attuazione della direttiva 98/83/CE relativa alla qualità delle acque destinate al consumo umano." (Regulating water quality for drinking water).

D.L. 30/2009 "Attuazione della direttiva 2006/118/CE, relativa alla protezione delle acque sotterranee dall'inquinamento e dal deterioramento". (Regulating the protection of groundwater from pollution and degradation).

D.M. 367/2003 concerning dangerous substances.

Decreto 131/2008 "Regolamento recante i criteri tecnici per la caratterizzazione dei corpi idrici (tipizzazione, individuazione dei corpi idrici, analisi delle pressioni) per la modifica delle norme tecniche del decreto legislativo 3 aprile 2006, n. 152, recante: «Norme in materia ambientale», predisposto ai sensi dell'articolo 75, comma 4, dello stesso decreto". (Regulating the characterization of water bodies).

Decreto 17 luglio 2009 "Individuazione delle informazioni territoriali e modalità per la raccolta, lo scambio e l'utilizzazione dei dati necessari alla predisposizione dei rapporti conoscitivi sullo stato di attuazione degli obblighi comunitari e nazionali in materia di acque". (Regulating the collection, exchange and use of data to assess the compliance of water related obligations).

Decreto 260/2010 "Regolamento recante i criteri tecnici per la classificazione dello stato dei corpi idrici superficiali, per la modifica delle norme tecniche del decreto legislativo 3 aprile 2006, n. 152, recante norme in materia ambientale, predisposto ai sensi dell'articolo 75, comma 3, del medesimo decreto legislativo". (Regulating the characterization of surface water bodies).

D.Lgs. 49/2010 "Attuazione della direttiva 2007/60/CE relativa alla valutazione e alla gestione dei rischi di alluvioni" (On the assessment and management of flood risk).

For example for Emilia-Romagna Region, this is the main regional legislation:

DGR n. 2067/2015 "*Attuazione della Direttiva 2000/60/CE: contributo della Regione Emilia-Romagna ai fini dell'aggiornamento/riesame dei Piani di Gestione Distrettuali 2015-2021*". (Emilia Romagna region contribution to the re-analysis/update of the Water District Management Plans).

DGR n. 1781/2015 "*Aggiornamento del quadro conoscitivo di riferimento (carichi inquinanti, bilanci idrici e stato delle acque) ai fini del riesame dei Piani di Gestione Distrettuali 2015-2021*". (Update on the knowledge in terms of pollution, water balance and water status to support re-analysis of the Water District Management Plans).

Delib. Cons. Reg. n.40 del 21/12/2005 "*Approvazione del Piano di tutela delle acque*" (approval of the Water Protection Plan).

DGR n.2135/2004 "Rete di monitoraggio delle acque sotterranee" (Monitoring network for groundwater resources).

DGR n.1053/2003 "*Direttiva concernente indirizzi per l´applicazione del D.Lgs. 152/1999, come modificato dal D.Lgs 258/2000, recante disposizioni in materia di tutela delle acque dall´inquinamento*". (Regulation for protecting water from pollution).

DGR n.1420/2002 *Rete regionale di monitoraggio delle acque superficiali interne*. (constituting therRegional network to monitor surface inland waters.

D.G.R. 1 marzo 2000 n.651 "*Direttiva concernente i primi indirizzi per l´applicazione del d.lgs. 11 maggio 1999 n. 152*" (Preliminary instructions for the implementation of the Law on Water Protection).

L.R. 6 settembre 1999 n.25 "*Delimitazione degli ambiti territoriali ottimali e disciplina delle forme di cooperazione tra gli enti locali per l´organizzazione del servizio idrico integrato e del servizio di gestione dei rifiuti urbani*" (Identification of Optimal Territory Environment Agency).

L.R. 24 aprile 1995 n.50 "*Disciplina dello spandimento sul suolo dei liquami provenienti da insediamenti zootecnici e dello stoccaggio degli effluenti di allevamento*". (Regulation on manure application from livestock farming).

L.R. 29 gennaio 1983 n.7 "*Disciplina degli scarichi delle pubbliche fognature e degli insediamenti civili che non recapitano in pubbliche fognature. Disciplina del trasporto di liquami e acque reflue di insediamenti civili e produttivi*". (Regulating the domestic waste water systems).

L.R. 28 novembre 1986 n.42 "*Ulteriori modifiche e integrazioni alla L.R. 29 gennaio 1983 n. 7 recante "Disciplina degli scarichi delle pubbliche fognature e degli insediamenti civili che non recapitano in pubbliche fognature" - Provvedimenti per il contenimento dell´eutrofizzazione*" (Regulating the reduction of euthrophication).

DGR n. 2515/2001 "*Affidamento ad ARPA -SMR delle funzioni di gestione unitaria delle reti di monitoraggio idro -meteo-pluviometrico*" (Commissioning to ARPA-SMR the function of unified management of hydrological, meteorological and rainfall monitoring.

DGR n. 975/2004 "*Approvazione dello schema di convenzione con Emilia Romagna, di attuazione della Direttiva PCM del 27.2.2004, che affida ad ARPA SIM il ruolo di Centro Funzionale della regione Emilia Romagna*". (Commissioning the ARPA-SIM the role of Functional Center in Emilia Romagna).

DGR n. 1166/2004 "*Approvazione delle linee guida per la redazione dei piani di emergenza provinciali e comunali, dove sono contenuti la struttura, gli strumenti del sistema regionale di protezione civile, gli scenari degli eventi attesi, il modello di intervento e gli indirizzi specifici per tipologia di intervento*". (Approval of the guidelines for provincial and municipal emergency intervention plans).

DGR n. 962/2009 "*Approvazione delle "disposizioni organizzative finalizzate all'attivazione del sistema di allertamento di protezione civile sul territorio regionale per il rischio idrogeologico-idraulico" in attuazione dell'art.12 della l.r. 1/2005*". (Approval of organizational procedures for civil protection alert about the hydrogeological and hydraulic risk).

Main River district plans

Piano di Gestione del Distretto Padano (Po District Management Plan), approved on March 3rd 2016;

Piano di Gestione del Distretto dell'Appennino settentrionale (Northern Apennine District Management Plan), approved on March 3rd 2016;

Piano di Gestione del Distretto dell'Appennino Centrale (Central Apennine District *Management Plan), approved on March 3rd 2016.*

Piano di Gestione del Distretto Alpi Orientali (Eastern Alps District Management Plan), approved on March 3rd 2016.

Main regional plans (regional subordinate plans, excerpts of RD plans)

Piano di tutela delle acque della Regione Emilia-Romagna, Water Protection Plan, approved on December 21st, 2005.

Piano di tutela delle acque della Regione Piemonte Water Protection Plan, approved on March 13th, 2007.

Piano di tutela delle acque della Regione Lombardia, Water Protection Plan, approved on December 12th, 2003.

Piano di tutela delle acque della Regione Liguria, Water Protection Plan, approved on December 17th, 2010.

Piano di tutela delle acque della Regione Veneto, Water Protection Plan, approved on November 5th, 2009.

Piano di tutela delle acque della Regione Friuli Venezia Giulia, Water Protection Plan, approved on January 19th, 2015.

All regional Plans are currently being updated to implement RBMPs approved in 2016.

2.2. Drinking water protection zones

- *Which are criteria for determining water protection zones?*

According to Italian D.Lgs. 152/06, the criteria for determining water protection zones are defined by the Regional Administrations at the proposal of the Water Services Regulation Authority; the regulation is finalized to avoid contamination of water resources for drinking water supply, from pollutants.

In Emilia-Romagna the protection zones for surface and ground water (drinking supply) were designated ("Water Protection plan" 2005); general demarcation criteria have been established on the basis of geological, hydrogeological, hydrological and hydrodynamic of springs, wells and supply points of surface drinking water. The leading criteria are: geometric, hydrogeological and temporal.

- *What limitations and restrictions have been declared within the water protection zones?*

Near the catchment with protected areas land use constraints are established, designed with the aim to ensure the appropriate quality of drinking water supply. The protection areas are designed through: "static security", "dynamic" or o "geometric" criteria.

The "static" protection consists of prohibitions, restrictions and regulations aimed at preventing deterioration in the quality of water at the catchment points, as well as measures and limiting land use for both quantitative defense and resource vulnerability.

The "geometric" protection and "dynamic" is applied in the buffer zones.

The "geometric" protection is established by a circular area of 200 meter radius from the catchment point ("Water Protection plan" 2005).

The "dynamic" protection is formed by the activation of a management system to monitor water quality in the catchment inflow able to check the quality parameters to allow the reporting of any resource faults.

- *Who controls and manages legal acts for determination of drinking water protection zones?*

The legal acts for determination of drinking water protection zones are controlled and managed by Water Services Regulation Authority (in Emilia-Romagna ATERSIR) and Regional Administrations.

- What is the procedure of drinking water protection zones implementation?

Drinking Water Protection Zones (DWPZ) are designed on basis of field investigations and desk studies.

  - How DPWZ are transferred to the space and how DWPZ are considered in the spatial planning procedures?

The delimitation of recharge areas and of the protected zones, of surface and groundwater waters, have been designated by the aid of geological, hydro-geological, hydrological and hydrodynamic field and desk studies, of springs, aquifers and surface waters exploited for water supply. The DWPZ, defined by cartographic delimitation, are considered in the planning procedures (PTCP and PSR) and local authorities must make provisions in relation to protection zones for the protection of water resources.

  - Who are parties with whom DPWZ are discussed (e.g. local communities, water managers, land owners, any other party)?

The regulations of drinking water protection zone from surface and groundwater resources can be integrated by Regional Administrations, by local authorities during planning procedures, by Water Services Regulation Authority and by Environmental and Health Agency with monitoring. These are the only stakeholders engaged in the process.

  - Are borders of DWPZ negotiated and agreed?

There is no procedure explicitly dedicated to the negotiation of the DWPZ limits, but the process of DWPZ drawing is agreed by stakeholders.

  - Are interdictions, limitations and measures negotiated?

Interdictions, limitations and measures are agreed in the planning process.

- Is there any coordination during this process?

Coordination is carried out by the authority competent for the preparation of the plan.

- In what extend opinions from the possible procedure must be accepted and how they are accepted?

Comments on DWPZ are either accepted or rejected during the planning phase, giving reasons for decisions made.

- How DWPZ borders are considered in the space and in the spatial planning process?

The DWPZ borders are drawn on cartographic maps, and specific regulations/restrictions of land use or activities are established.

- Are borders of DWPZ drawn so that they are following land plot (cadastral / parcel) borders?

No.

- Are borders of DWPZ drawn so that only design criteria are considered, no matter what are the ownership relationships in space?

Yes.

- Is the list of plots (cadastral parcels) positioned on the DWPZ prepared and it is publicly available or even published in the official documents?

No.

- Who and how is exercising control over the surface of DWPZ?

The Regional Environmental Agencies (ARPA/ARPAE/APPA) monitor compliance with the requirements for the dispersion of sewage treatment sludge, waste water and zootechnic effluents.

- How the breaches of the requirements defined on DWPZ are penalized?

The failure to observe the provisions relating to the activities and destinations prohibited in the drinking water protection zones is punishable by administrative fine.

2.3. Floods/droughts management

- In which way management of floods and droughts is regulated in your country?

Flood management is regulated by the Italian Laws D.lgs. 49/2010, according to the European Flood Directive 2007/60/EC and D.lgs 152/2006. These laws establish the Food Risk Management Plan and the District Hydrogeological Regulation Plan (PAI).

Flood alerting system is regulated by the Directive of the President of the Ministers Council on 27.02.2004 “Organization and functional management of the national and regional distributed

alerting system for hydrogeological and hydraulic risk for Civil Protection" (Fondazione CIMA, 2010).

Drought management is regulated by the Italian law D.Lgs. 152/2006, according to the European WFD 2000/60/EC. This law establishes the District Management Plan, containing the Water Balance Plan to manage drought and water scarcity. Also the Regional Water Protection Plans, introduced by the same Law, are instruments for water resources management and protection during drought events (Fondazione CIMA, 2011).

- Do you have flood/drought risk assessment done on national level?

On national level, flood risk assessment derives from the collection of Flood Risk Management Plans and Hydrogeological Regulation Plans developed by all the River District Authorities.

No drought risk assessment is done at national level, because the Law R.D 1775/1933 requires the nomination of an emergency commissioner in case of drought/water scarcity events.

Many River District Authorities have developed drought risk assessment within the Water Balance Plan, as part of the River Basin Plan.

The permanent national network of "Observatories on water uses" established on 13 July 2016 is also charged with assessing temporary water scarcity and shortage events. This network considers three scenarios, low, medium and high, for temporary water scarcity.

- If yes, have you designated areas for which significant risk of flooding/droughts is estimated?

According to the D.P.C.M. 29/9/1998 "Atto di indirizzo e coordinamento per l'individuazione dei criteri relativi agli adempimenti di cui all'art. 1, commi 1 e 2, del D.L. 11 giugno 1998, n. 180" River basin Authorities are charged with locating flood prone areas and dividing them into four Risk classes, from low risk areas (R1) to very high risk areas (R4).

There are no designated areas exposed to significant drought risk at national level. Many District Authorities have located these areas within their Water Balance Plan.

- Is there a map of floods/droughts risk?

The Italian National Institute for Environmental Protection and Research, ISPRA, yearly publishes the updated maps of flood risk, deriving from the collection of flood risk maps supplied by every Italian River District Authority. There is not a national map of drought risk. ISPRA has also published a report about desertification prone areas in Italy and another about guidelines for locating aridity and desertification prone areas.

- Whether an estimation of potential flood damage has been done?

Yes, it has been done at national level, considering flood exposure, vulnerability, hazard maps and the number and location of exposed people as well.

2.4. Water quality state, trends and monitoring

- Who performs monitoring of drinking water quality, which parameters are routinely observed and how frequent?

According to D.Lgs. 31/2001 monitoring of drinking water quality is carried out by water service provider (told "internal monitoring") and by public health service ("external monitoring"), ASL (Local Sanitary Authorities) and/or environmental Agencies for laboratory analysis.

The analytical screening includes: pathogenic microorganisms and not (Escherichia coli, total coliforms, enterococci and so on), chemical substances (cyanides, chlorides, chlorites) and pollutants (heavy metals, chlorinated organic solvents, PHA and other organic micro-pollutants). There are two types of analytical screening: one with complete set of parameters (low frequency) and one (routine) regards a sub set of 16 substances (high frequency). Public (External) monitoring frequency is related to the amount of water supplied: minimum routine monitoring frequency is four samples per year and minimum complete monitoring frequency is one sample per year, while for a very large water supplying could be necessary about 130 routine samples per year and 15 complete check samples per year.

- Who performs monitoring of drinking water resources (surface water, groundwater…) quality, which parameters are routinely observed and how frequent?

According to D.Lgs. 31/2001 and D.Lgs 152/06 monitoring of drinking water resources is made both by water service provider ("internal monitoring") and public health service ("external monitoring).

In detail:
- monitoring the quality of surface waters requires a wider set of parameters than WFD classification monitoring scheme: parameters observed are physical (pH, temperature, conductivity, etc.), microbiological (Escherichia coli, Total coliforms and Enterococci), chemical (Ammonium, nitrates, Fe, Mn, B, As, Cu, Hg, Pb, etc), complete list is on Section A of Annex 2 to Part 3 of D.Lgs 152/06; the monitoring frequency vary from 4 to 12 samples per year depending on the served population
- the set of parameters required for ground waters chemical status classification monitoring, is composed by a "base set" and "additional sets"; base set is analyzed for all the monitoring sites, while additional sets analyses are related to pressure analysis results; some parameters are strictly required by D.L. 30/2009 while others are deducted from pressure analysis results; base set include pH, °T, nitrates, nitrites, ammonium, B, Fe, Pb, Cd, etc., additional specific sets regards pesticides, Escherichia coli, organohalogens and hazardous substances (complete lists are on reports of the results of monitoring periodically produced by Region Emilia-Romagna and ARPAE); frequency of sampling is half-yearly (quarterly in the first phases for new monitoring points).

- Is there systematic monitoring of quality parameter trends for drinking water and for their resources? Who performs this monitoring?

Critical issues on drinking water quality trends are analyzed in the process of periodical updating of the Water Protection Plan (regional excerpt of the RBMP).

➢ Who is the user of this data?

Public health service is the main user of the monitoring data for checking the compliance with legal standards of the water service; drinking water surface resource monitoring data and groundwater-monitoring data are analyzed by Region Emilia-Romagna and ARPAE in the process of periodical updating of the Water Protection Plan (regional excerpt of the RBMP).

➢ Which is the procedure in the case of negative quality trends?

Critical issues emerging from negative quality trends are examined, with the help of pressure analysis, to detect the main cause of the risks, and the appropriate measures are settled and included in the Program of measures in next RMBP / "Water Protection plan" updates. Critical issues due to sudden phenomena are faced with emergency measures.

3. Actual land use activities

3.1. Land use map

Figure 1 represents the Italian land use map based on the Corine Land Cover (CLC) 20121, Version 18.5.1, published on 19 September 2016. The CLC map covers 32 EEA member states and 7 cooperating countries, including Italy. The coordinate reference system is the standard European coordinate reference EPSG:3035 (ETRS89, LAEA). The CLC nomenclature is hierarchical, including three levels of thematic detail (indicated by 3 digits) in five major classes, i.e. class 1 (artificial areas), class 2 (agricultural areas), class 3 (forest and semi-natural areas), class 4 (wetlands) and class 5 (water bodies). In addition to pure land cover classes, the nomenclature includes land use classes, while some classes have a mixed land cover/land use character (e.g. Class 11 Urban fabric, Class 111 Continuous urban fabric). Altogether, there are 44 classes on level-3 (see

Table 3).

It can be seen clearly from Figure1 and

Table 3 that agriculture areas, forest and semi-natural areas cover the majority of Italian territory (i.e. 52.25% and 42.46%, respectively) while other classes (i.e. artificial areas, wetlands and water bodies) just account for 6,41%. It is noteworthy that more than half of agriculture areas (i.e. 51.37%) are represented by non-irrigated arable land, which accounted for 26.84% of Italian land area. These areas either can be cultivated without artificial water supply using permanent infrastructure or can be abandoned areas, which are identified as areas of arable land, which has not been used for 1-3 years. On the contrary, permanently irrigated lands, which cannot be cultivated without artificial water supply, just account for 0.26% of agriculture areas and for 0.14% of total national area. For what concern forests and semi-natural areas, broad-leaved forest areas dominate other sub-classes, accounting for 43.44% of this class and 18.45% of total Italian area.

[1] http://land.copernicus.eu/pan-european/corine-land-cover/clc-2012/view

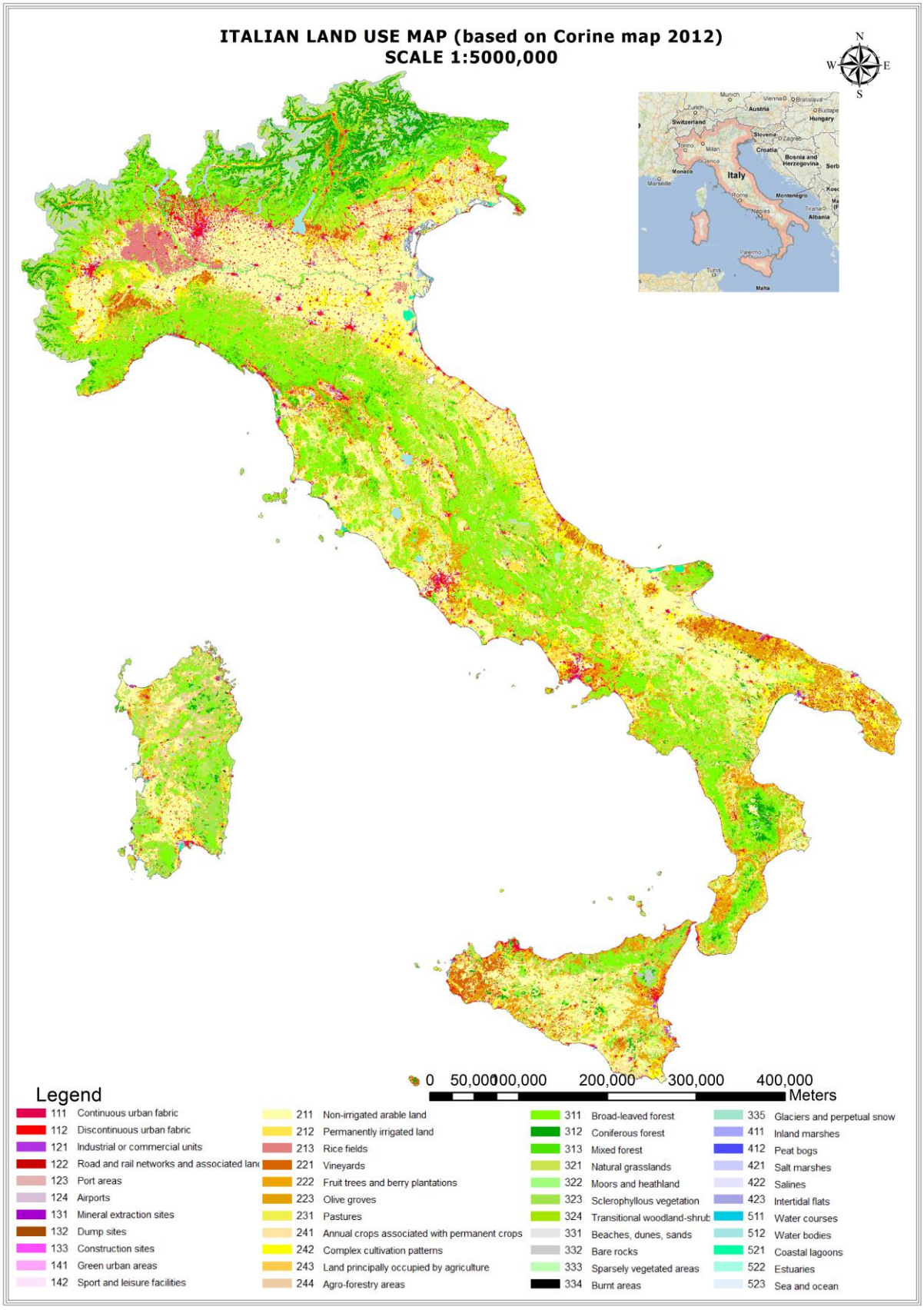


Figure 1. Italian land use map

Table 3. Classification of Italian land use

CLC code	LABEL 3	Surface area (km^2)	Surface area (%)
111	Continuous urban fabric	1,405.45	0.47%
112	Discontinuous urban fabric	10,184.43	3.39%
121	Industrial or commercial units	2,829.59	0.94%
122	Road and rail networks and associated land	152.01	0.05%
123	Port areas	110.60	0.04%
124	Airports	227.25	0.08%
131	Mineral extraction sites	507.21	0.17%
132	Dump sites	28.05	0.01%
133	Construction sites	43.82	0.01%
141	Green urban areas	112.44	0.04%
142	Sport and leisure facilities	285.41	0.09%
211	Non-irrigated arable land	80,724.69	26.84%
212	Permanently irrigated land	409.33	0.14%
213	Rice fields	2,950.39	0.98%
221	Vineyards	5,766.61	1.92%
222	Fruit trees and berry plantations	4,213.70	1.40%
223	Olive groves	12,032.58	4.00%
231	Pastures	4,286.50	1.43%
241	Annual crops associated with permanent crops	2,037.71	0.68%
242	Complex cultivation patterns	21,854.66	7.27%
243	Land principally occupied by agriculture, with significant areas of natural vegetation	21,175.95	7.04%
244	Agro-forestry areas	1,703.68	0.57%
311	Broad-leaved forest	55,474.52	18.45%
312	Coniferous forest	12,917.35	4.29%
313	Mixed forest	11,010.53	3.66%
321	Natural grasslands	13,768.61	4.58%
322	Moors and heathland	1,485.40	0.49%
323	Sclerophyllous vegetation	10,135.22	3.37%
324	Transitional woodland-shrub	10,416.48	3.46%
331	Beaches, dunes, sands	728.03	0.24%
332	Bare rocks	4,296.45	1.43%
333	Sparsely vegetated areas	3,568.66	1.19%
334	Burnt areas	103.64	0.03%
335	Glaciers and perpetual snow	407.57	0.14%

CLC code	LABEL 3	Surface area (km^2)	Surface area (%)
411	Inland marshes	185.00	0.06%
412	Peat bogs	4.10	0.00%
421	Salt marshes	337.26	0.11%
422	Salines	82.02	0.03%
423	Intertidal flats	#N/A	#N/A
511	Water courses	461.58	0.15%
512	Water bodies	1,731.26	0.58%
521	Coastal lagoons	396.25	0.13%
522	Estuaries	2.20	0.00%
523	Sea and ocean	200.75	0.07%
999	NODATA	#N/A	#N/A
990	UNCLASSIFIED LAND SURFACE	#N/A	#N/A
995	UNCLASSIFIED WATER BODIES	#N/A	#N/A
990	UNCLASSIFIED	#N/A	#N/A
SUM		300,754.92	100.00%

3.2. Overview of the particular land use activities

The purpose of this chapter is to point out frequently land use activities and techniques that have impacts on the ecosystem function "water resources protection and protection against floods".

3.2.1. Urban areas

In Italy, 28% of population (about seventeen million people) live in eighty five centers exceeding 40,000 inhabitants: specifically, 32 have less 150,000 in. and six exceed 500,000; moreover, Rome (2,872,021) and Milan (1,337,155) result the major cities. In terms of population density, large variations are observed from 8,220 in./km2 in Naples (Southern Italy) to 153 in./km2 in Olbia (Sardinia) [data updated to December 2014; Frizza et al., 2015]. Concerning water resources, over a water uptake of about 26 Mm3/d, the 30% is conveyed to water treatment plants; such value is also strongly conditioned by the source: groundwater resources (if not in highly anthropized areas) do not normally require purification processes while they are necessary for surface waters. In this regard, the highest percentages are detected for Basilicata (83%) and Sardinia (75%) regions while the minimum value is for Valle D'Aosta (3%) (ISTAT, 2012). In summary, groundwater, surface water bodies and marine or brackish water respectively cover about 85%, 15% and 0.1% of water demand. The water supplied per capita for domestic use is about 175 l/in./d (updated to 2011 for the 116 chief towns; ISTAT, 2012) with a remarkable decrease compared to 2008 survey (210 l/in./d; -16%); however, large variations are detectable among the urban centers with values ranging slightly over 100 l/in./d for Arezzo (Central Italy) and nearly 250 l/in./d for Catania. In this regard, a crucial role is played by pipeline leakes;

indeed, the difference in percentage between water fed into the network and dispensed amount reveal losses above equal to 50% for 27 cities over 84 while only in 8 cases it does not reach 15% (average value 37%) (De Gironimo et al., 2015). About waste waters, in terms of population equivalent (p.e.- expressed as 54 grams of BOD over 24 hours), four cities have values close to or greater than two millions (in order, Rome, Turin, Milan and Naples) while in other nine cases 500,000 in. are passed. Although 91/271/CEE (Art.3) limits the use of individual systems to conditions where "no environmental benefit" or "excessive cost" are recognizable, in 33 over 85 cities their use is over 2% and in 10 cases exceeds 10% (22% for Venice, 36% for Pordenone and 50% for Catania). Moreover, in such contexts, a non-negligible fraction of waste waters result not conveyed in treatment plants: i.e. 3% in Naples, 4% in Genova and 9% in Catania (UWWTD Questionnaire 2013; Salvati et al., 2015). On the other side, in about 30 cities all wastewater is recognized channeled into sewers. To assess the diffusion of water treatment plants on the national territory, the ratio between unit per capita loading produced and that reaching the plants is investigated: for 54 towns it ranges between 95% and 100%, in 29 cases it is over 60% while for Benevento and Catania (Southern Italy) it is about 20% (UWWTD Questionnaire 2013). Furthermore, other interesting information arise by monitoring of percentage of waste water that, after the treatments, comply with limits set by 91/271/CEE in terms of concentration (mg/l) or reduction percentage. In this regard, reference parameters are BOD5, COD and nutrients (only for sensible areas). Such areas are defined as already eutrophic or prone to eutrophication. For 62 centers, the percentages are higher than 75% (100% for 29 cases) while, for 11 cities, they are lower than 25% (6 in South and 5 in North Italy) [UWWTD Questionnaire 2013]. Up to 2012 (ISTAT, 2012), over 18,000 plants were recognized working in Italy; the largest part is located in North-West Italy (35%). If they are discriminated according typology, about 8,000 Imhoff tanks, 2000 plants with primary treatments, 6000 with secondary and over 2000 with tertiary treatments are reported. However, in terms of population equivalent, the first two serve less than 4 Million while the other two respectively 26M and 45M p.e..

3.2.2. Industrial areas

According ISTAT (2011) survey, in Italy manufacturing enterprises employ about 4 million people (2,6M in North, 662K in Central and 549K in South Italy). In this regard, are considered only activities labelled as "Manufacturing activities" by ATECO 2007 Italian classification (ATtività ECOnomiche, Economic Activities) implementing European NACE Rev.2 (Statistical classification of economic activities in the European Community). Six sectors cover around 74% of employees: manufacture of basic metals and fabricated metal products (17%), textiles and similar (13%), machinery and equipment (12%), food and beverage (11%), rubber and plastic products (10%), other manufacturing including repair and installation of machinery and equipment (11%). Concerning water resources, slightly over 5 billion m^3 of water have been used in 2012 (the only year for which investigations are currently available) (Istat - Eurostat Grant agreement 2013). Three sectors exert a high water demand (about 33%): manufacture of chemicals and chemical products (681Millions of m^3), rubber and plastic products (645M) and manufacture of basic metals (552M). Furthermore, other high water consuming sectors including, for example, textiles, food and beverage, paper and related products exploit about 34% of water. An effective way to investigate environmental pressure is given by Water Use Intensity (WUI) Indicator representing, for sector, the ratio between consumed water and sold production on yearly scale. According ISTAT analysis (2016) for 2012, higher WUI values are returned for textiles sector (25.1 l/€); moreover, for six sectors values ranging between 17 and 19 liters are estimated. In this

regard, less water demanding sectors (4 or less l/€) include food production, leather and related products and pharmaceutical preparations. Moreover, it is interesting to observe how greatly higher WUI values are found for mining and quarrying activities (about 70 l/€). Regarding the sources of water supply, enterprises with less than 5 employees usually adopt drinking water provided by civil pipelines (195K m^3) while medium and large firms use systems at their exclusive service or serving industrial clusters (ISTAT, 2016). Concerning wastewaters, ISTAT (2012) displays how 19.5% of waters undergoing treatment derive from industrial facilities (respectively, 21%, 25% and 13% for North, Center and South Italy). They correspond to about 14M of p.e. over an overall value of around 75M.The significant decrease with respect the previous 2008 survey is primarily due to increase in greater pollution load from domestic use and the economic crisis leading to the closing of many activities. Furthermore, through European Pollutant Release and Transfer Register (E-PRTR), a first picture about pollutant releases to water can be furnished. Indeed, such register, established after Regulation (EC) No 166/2006, report data on the main pollutant releases to air, water and land of about 28,000 industrial facilities across the European Union and EFTA countries and on off-site transfers of waste water and waste from these facilities. Currently, the available most recent data are for 2014. Considering, for Italy, again only "Manufacturing activities", 1652 facilities have provided data regarding air and water pollutant releases; regarding the most dangerous substances, it can be note that 427 t of heavy metals are declared released in water bodies (about 172 t for Zn, 93t for Cr and 63 for Ni). Concerning inorganic substances, are detectable high amount of chlorides (2590410 t with 14310 t accidentally released) while nitrogen and phosphorus releases respectively amount to 28866.3 t (44.6 t accidentally released) and 2896.2 t (4.89 t) and 219 kg for pesticides. The comparison performed by NGO environmental organization Legambiente (2014), for 2011 data, with corresponding provided by the most developed European countries (France, Germany, UK) reveals how in Italy the direct input of chemicals releases by industrial activities in the surface water bodies is still high with potential extremely negative consequences. A further interesting information is provided by data about pollution releases of wastewater treatment plants; indeed, they represent a "measure" of effectiveness of treatments. In this regard, available data (source E-PRTR) display how, also after treatments, remarkable amounts of pollutants are released in water bodies; for the 19 facilities considered in the survey, for example, about 53t of heavy metals and about 60kg of pesticides; indeed, as they are often designed primarily for civil/domestic wastewaters, they do not include in the treatment "ad hoc" processes for industrial wastewaters.

3.2.3. Agricultural land

Agriculture is one of the main economic sectors in Italy: in 2010, 43% of the country territory was devote to agriculture, including arable land, permanent grassland and meadow, permanent crops and kitchen gardens (http://ec.europa.eu/eurostat/statistics-explained/index.php/Agricultural_census_in_Italy).

Still according to 2010 data, Italy was 2nd among EU countries (after Romania) in terms of number of agricultural holdings, reaching 1,620,880.

Agriculture consumes large quantity of water in Italy, around 11,600 million metric cube in the agricultural season 2009-2010. Indeed Italy is 2nd after Spain (http://www.istat.it/it/files/2014/11/Utilizzo_risorsa_idrica.pdf) in terms of irrigated hectares (2.4 million) and share of irrigated area with respect to the Utilised Agricultural Area (UAA) (19%). However, the potential for irrigated surface is exploited at 66%. Large differences exist

between the North, Centre and South of Italy, with the North consuming two times the water volume per hectare with respect to the Centre and the South, and presenting more than four times the share of irrigated area of the UAA. Thus 73% of irrigation in Italy occurs in the North (especially in the North West), almost 23% in the South and major Islands, and the remaining in the Central territories. Also in case of organic farming, irrigation is concentrated in the North-Western regions, but directly followed in this case by Southern regions as Sicily, Puglia and Calabria. In general, plans host most of irrigation practices (72% of total and 42% of the UAA).

The cultivation having the largest share of irrigation water, in terms of surface, is maize (21%). Temporary and permanent grass accounts for another 15% of irrigated area, followed by rice (12%) and vegetable crops (10%). However, that rice surface influencing irrigation corresponds to almost 40% of irrigation in terms of water volumes, while maize represent almost 16% of water volumes. Other crop categories (citrus, fruits, vegetables) represent each less than 10% of water volumes used for irrigation. The share in volume is more or less the same in case of organic farming.

Used water is of public origin (aqueducts and/or irrigation consortia) for the 63%, mainly in the North, while the remaining sources are managed privately (53% and 47% from underground and superficial resources, respectively). Around 62% of the system is at low efficiency (datum mainly affected by the "submersion" practice adopted for rice) while 38% has high efficiency (e.g. drip or sprinkler irrigation); organic farming is committed to use most efficient systems, with twice utilization of drip systems.

From a water quality point of view, fertilizers and pesticides remain the main problems although their gradual reduction (since 2000) thanks to the diffusion of organic farming (ISPRA, 2016). Several laws and norms in the last two decades regulate the use of organic and mineral fertilizers. First, the EU Nitrates Directive (1991) fixed to a maximum of 170 kgN/ha/year the amount of manure to be applied on soil and to 50 mg/l the maximum amount of nitrates admitted in water bodies. This Directive was then reinforced by EU Directives in 2000 and 2006 (for Water in general and for underground waters, respectively) and, from 1999 to 2014, by Italian legislation aiming at regulating the impact on water resources from agriculture and the role of organic waste treatments, mainly favoring good agricultural practices and by identifying vulnerable areas. Mineral fertilizers are still the most used (45%), followed by organic fertilizers and improvers of mechanical soil characteristics (35%), and by products corrective of soil chemical-physical properties, mixed organic-mineral products, cultivation substrates, and more specific product to improve absorption of nitrates by soil and to correct physiological anomalies.

The other threats for water bodies are phytosanitary products (PP), also regulated by specific Strategies and Directives, and by cross-sectoral governing instruments as the Water Directive. From 2004 to 2014 the active ingredients in PP decrease, but in the year 2013-2014 there was an inversion of tendency. Both long term and short-term trends are opposite for organic active ingredients. The most treated crops are vineyards and tomato (more than 10kg/ha of active ingredients).

The quantitative and qualitative impacts on water from agriculture are influenced by climate change and extremes like drought and floods, and fluctuation of them, that are tackled with emergency intervention rather that prevention measures. Floods cause irreversible damages and wide economic losses, while droughts are handled by increasing irrigation and thus impacting on other sectors competing for water resources. In this sense, prevention measures should favor the implementation of hydraulics works in the upstream and riparian areas to protect fields from inundation, proper ploughing to improve soil hydraulic and drainage properties and mitigate soil

saturation risks, the selection of crop varieties more drought resistant, or the use of more efficient irrigation systems to save water resources.

3.2.4. Forest

According to the last national inventory on forest and forest carbon sink (INFC, 2015) the Italian forested surface, based on the international definition adopted by the Global Forest Resources Assessments (FRA), cover 10,982,013 hectares (i.e. 34% of the national territory), showing an increase with respect to the 10,345,282 hectares estimated in the previous inventory (INFC, 2005), and a +300% of coverage in the last 60 years, due to the gradual abandonment of the mountainous areas and of agro-silvopastoral systems.

The forested surface (forestland) consists of the macrocategory "forest" (84% of the total and 29% of the national territory), and of the the macrocategory "other forestlands", made of shrublands and Mediterranean maquis.

In terms of landscape composition, 44.4% of forests are close to agricultural areas, 28% adjacent to grassland, pastureland and uncultivated lands, 8.7% are near low or no vegetated zones, and 4.7% and 0.9% close to water bodies and wetlands, respectively. For the "forest" macro-category of forested lands, the density range from 62.6% of Liguria region to 7.5% of Puglia, while 67.5% of forests have a total coverage of 80%. For the macrocategory "other forestlands", 60.3% of the surface presents a coverage higher than 50%, and 38.6% higher than 70%.

Forests are made for about 75% by needleleaf communities (most diffused forest formations: Sessile, Pubescent and English oaks, common beech, chestnut and Turkey, Hungarian, Macedonian and Valonia oaks), except for several alpine areas in Valle D'Aosta and Trentino Alto Adige, and for 15% by coniferous dominated by spruce (586,082 hectares that correspond to about 6,7% of forests in Italy); the remaining 10% consist of mixed communities. The main management practice is coppice (41%, 3,663,143 hectares) with prevalence of coppice with standards (35%), mainly represented by forest stands near to the utilization period or aged.

High stands occupy 36% of Italian forests (3,157,965 hectares), with slightly prevalence of even-aged (15.8%) rather than multi-aged (13.5%) and they are mostly represented (50%) by mere coniferous, especially spruce, silver fir, European larch, Mountain and Mediterranean pines. The most productive coniferous are in the North-East. Moreover, cultivation typologies considered special (chestnut, black walnut, cork oak) represent a significant genetic and economic local resource, and they cover around 200,000 hectares (INFC, 2005).

Forest plantations cover 1.12% (122,252 ha) of forests, whose 84% are pure broadleaved with a prevalence of poplar (66,269 ha) and noble hardwood and Eucalyptus (40,985 ha).

The net removal of CO2 from the atmosphere by Italian forests is 34 Mt/year, considering losses due to wood harvest, fires and other biotic and abiotic disturbances. According to the INFC (2005), the 81.3% of Italian forestlands is available for wood harvesting, corresponding to about 35.5 Mm3 of wood. However, the wood volume effectively harvested through silvicultural operations is less than 9 Mm3 (whose more than 60% is wood for energetic use) according to FAOSTAT, and around 13.5 Mm3 according to INFC (2005). Data about harvesting, probably underestimated, mainly by FAOSTAT that does not consider the utilization of small forest properties (< 3ha) for which cutting is declared but without information about the harvested volumes, are between 25% and 38% of yearly production, and largely lower than the average of EU-28 countries that is around 65% of the yearly production (MCPFE, 2015).

Around 1,854,659 hectares of forestlands (17.7% of the total) are interested by infrastructures. In terms of property, 63.5% are private, 32.4% public and around 4% unclassified.

Some important restrictions interest Italian forestlands: 81% of them (87% of forests) are under hydrogeological constraints (Royal Decree 3267/1923; i.e. soil working or movements are not possible without demonstrating they do not alter the hydrogeological equilibrium of the area), so that 77% of forests' soils are not interested by instability. The 27.5% of forestlands are under environmental restrictions (mainly in the Centre and South): National Parks, Regional Reserves and Natura 2000 network (SIC and ZPS) occupy 7.6%, 6.7% and 22.2% of the forestlands.

Forests are strategic for soil instability/landslide mitigation and water cycle regulations. Forest cover in general reduce runoff and erosion thanks to interception of rainfall from canopy vegetation and increase water storage in soils by reducing evaporation; moreover, tree roots have a stabilization role on soil particles. However, usually forests are also the dominant land cover/use on steepest slopes, where hydrogeological instability and superficial water flow are facilitated by gravity. This is the reason why correct forest management is crucial to avoid for example that woody debris increase weight on the hillslope or are transported by runoff and create barriers in the river channels. Finally, protecting forests by fires is crucial as fires effects consist not only of direct damage of vegetation but also on alteration of physical and chemical soil properties, as loss of organic matter, increase of bulk density, reduction of soil porosity and infiltration capacity, and increase of soil water repellency.

The most used species to consolidate hillslopes are: *Acer campester*, *Robinia pseudoacacia*, *Carpinus betulus*, *Quercus pubescens* and *Sorbus domestica*, while along riparian areas, to reinforce river banks or adjacent areas, the most appropriate species are: *Salix alba*, *Alnus glutinosa*, *Morus alba*, *Sambucus nigra*.

3.2.5. Pastures

Livestock farming represent almost 1/3 of the Italian agricultural production, corresponding in 2013 to more than 17.5 MEuros, with meat representing more than 60% of production value, followed by milk, eggs and honey (CREA, 2016). Livestock farming is mainly intensive, with farms well distributed but animal heads concentrated in few areas (the North). Because of this concentration, many parts of the Country's territory are suffering from pressures on the environment and on the economic costs, because of the need to be compliant with severe Laws and Directives as the Nitrate Directive (1991). To give an idea, Lombardy hosts 25% of bovines and more than 50% of swines, while more than 40% of sheep and goats are concentrated in Sardinia. However, livestock sector is not only intensive and concentrated on the plans but it is also active in hilly and mountainous areas of the Centre and the South to value local production contributing also to environmental protection. In the last decade, there was an increase if farm size, and especially in in the North West the share of livestock farming over the whole agricultural sector almost doubled rising by 17% and reaching 31%.

The Legislative Decree 152/2006 (known as "Environmental Code") and its integrations in the Legislative Decree 128/2010, are the main texts on pollution, and also regard the livestock sector and implement the EU Water and especially Nitrates Directives concerning the need of monitoring both superficial and underground water bodies, the definition of vulnerable areas, the identification of good practices and the adoption, implementation and monitoring of actions. If the livestock activity is conducted within a vulnerable area to nitrates, the yearly average nitrogen load should be less than 170 kgN per hectare, included the manure applied and left on

pasture. In general, during autumn and winter both mineral and organic fertilizers are prohibited, and storage facilities or removal of livestock manure are required during periods of prohibition. The use of fertilizers and manures should be limited to the crop needs, and application on saturated or flooded soils, on soils with very shallow groundwater or covered with snow or ice, or on steep slopes (>10%) is not permitted. The application should be as much homogeneous as possible and respecting distances from water bodies. All data about fertilizers and manure should be registered by farmers together with information about farming practices.

For farms exceeding in the production of animal-source nitrogen, the limit of 170 kgN per hectare per year was changed (in 2011) to 250 kgN/hectares but only for bovine and swines, and only if farmers, on at least 70% of the UAA, conduct long-season cultivations that uptake nitrogen. To manage livestock manure it is required that 2/3 is applied by the end of June, and the remaining by the end of October, so to maximize nitrogen use efficiency.

However, the EU Nitrates Directive is a dynamic one: water quality should be monitored in the meantime, and both vulnerable areas and actions plans need to be updated (at least every 4 years). The Nitrates Directive is today embedded into the Water Framework Directive and is one of the Mandatory Management Criteria in the context of eco-conditionality of the Common Agricultural Policy.

3.2.6. Transport units

ACI (Automobile Club d'Italia-Italian Car Club) reports in detail the features of the national road network updated at 2011 discriminating on the basis of road type or its location. At National level, the entire network road extends for 154,000 km; in the specific, highway network extends for about 7,000 km (27% in North-West [NW] Italy,23% in North-East [NE], 18% in Central [C] Italy, 22% in South [S] and 10% in Insular [I] areas), primary roads for 20,423 km (about 10% for NW, NE and C, and about 33% for S and I), secondary roads are about 8000km while provincial ones extend for over 100,000 km. On average, the ratio between road length (km) and surface (km^2) returns at national level a value about equal to 0.5 while the ratio between road length and population is about 0.25. Concerning the management of wastewaters from roads, the reference legislation is represented by 152/2006 Law; in the specific, the article 113 addresses the matter. According it, control and management of wastewaters produced by precipitation that, through runoff processes, wash out impervious surfaces has to be regulated at Regional level. Moreover, Regions regulate treatments and permissions for "acque di prima pioggia" (first rains) and washing waters considered most polluted. In particular, the identification of activities for which more significant hazards may arise in terms of stormwater contamination are required. In this regard, the regional regulation adopted by Lombardy (L.R. 4/2006) could represent a valuable example. It defines "acque di prima pioggia" as the first 5 mm fallen on the draining surface while to discriminate between two distinct events, it considers an interarrival time longer than 96 hours. After, it defines in detail activities subject to regulation (i.e. chemical, concrete, leather, paper, textiles industries or car repair services). Then, it prescribes that first rains or washing waters, in these cases, should be separated from the remaining, stored in specifically sized tanks and subject to treatments that allow the reduction of pollutants below required thresholds. For what concern the activities carried out to prevent freezing on the roads, for example the main highway company operating in Italy, Autostrade s.p.a., drew up the "Plan for Management of Snow Emergencies" in which are reported in detail procedures for operators and drivers to follow in case of snow; moreover, the location of deposits for calcium

chloride (168) and of vehicles (i.e. snow blades, salt spreaders) is indicated. Finally, five color codes allow communicating to drivers the hazard level.

3.3. Impact of land use activities on water quality and floods/droughts - DPSIR approach for the present/past state

The DPSIR framework, proposed by the European Environmental Agency (EEA, 1995), was developed with the aim of describing the relationships between the origins and consequences of environmental problems (EEA 1999; Kristensen 2004; Khajuria & Ravindranath 2012). It has been widely used to help the conceptualization of risk assessment problems (Kelble et al. 2013) and for Integrated Water Resources (IWR) management (Pirrone et al. 2005; Mattas et al. 2014; Sun et al. 2016; Bagordo et al. 2016; El Sawah et al. 2011).

In principle, the DPSIR framework defines a chain of causal links starting with the identification of the 'drivers': the main natural and anthropogenic forces which can determine an effect on natural or human systems. The main drivers of water resources alterations are represented by environmental and socio-economic factors (e.g. urbanization, population growth, climate and land use changes, deforestation) that exert direct or indirect 'pressures' on water bodies. Increased irrigation or industrial-domestic demands, decreased precipitation, point or non-point source pollution could be considered as pressures. Pressures can vary among geographic regions, spatial and temporal scales causing changes in the 'states' of water resources both in qualitative (e.g. alteration of water quality parameters) and quantitative (e.g.water scarcity or surplus) terms. Finally, changes in the state of the system can cause 'impacts' (i.e. flood, drought, water contamination) threating environment, human health and activities, and eventually leading to 'responses', those measures taken to control the impacts and to improve the state of the water body.

The DPSIR (Driving forces, Pressures, States, Impacts and Responses) approach is here proposed to identify the main cause-effect relationships and interactions between land use, climatic changes and the quality of water resources and flood/drought risk at a national level.

Impact on water resources quality				
URBAN AREAS				
Driving forces	Pressures	State	Impacts	Responses
Increase in population density	Increase in the volume of waste water and sewage to be treated	Alteration of phosphorous, nitrogen, dissolved oxygen, BOD, COD and pathogens concentration in treated waters	Unfit for drinking and irrigation Impacts on human health Eutrophication	KTM 21 Optimization of urban waste water management systems Increase effluent treatment
Expansion of artificial and concrete surfaces	Increase of runoff rates Increase of erosion rates	Increase concentrations of nutrients, heavy metals, salts and sediments delivered through runoff into surface and ground water bodies	Unfit for drinking and irrigation Impacts on human health Eutrophication	KTM6, KTM7, KTM17,KTM23 Creation of green and blue infrastructures in urban areas (i.e. green roofs, parks, urban ponds and wetlands)
Sewage overflows in case of extreme rainfall events	Diffuse pathogens and organic matter contamination	Presence of pathogens and into ground waters	Impacts on human health (i.e. vector borne diseases)	KTM 21 Optimization of urban waste water management systems Improvement of urban drainage system
Non-compliant urban and domestic wastewaters treatment plans	Effluents nutrients and pathogens concentrations above allowed standards	Values of nutrients and pathogens above the maximum allowable concentration for drinkable water	Unfit to drinking Impacts on human health Eutrophication	KTM 21 Increase effluent treatments
Intensity of tourism supply	Volume of sewage to be treated exceeding waste water systems capacity	Alteration of phosphorous, nitrogen, dissolved oxygen, BOD, COD and pathogens concentration in treated waters	Unfit for drinking and irrigation Impacts on human health Eutrophication	KTM 21 Optimization of urban waste water management systems Increase effluent treatment Suistanable tourism
Areas without sewage systems	Direct discharge of nutrient, organic matters and pathogens i.e. coliformi, E.coli, Enterococchi) into surface and groundwaters	Values of nutrients, organic matters and pathogens above the maximum allowable concentration for drinkable water	Unfit for drinking Impact on human health (i.e. vector borne diseases) Eutrophication	KTM 21, KTM 15 Implementation of appropriate sewage system and devices for wastewater treatment
Lack of Emergency Municipal Plans for many	Procedures, roles and	Municipalities with approved Plan (39%	Higher risks for civil population in case of	KTM 14

towns in Central and Southern Italy	strategies are not specified for anthropic or natural induced disasters	in Campania, 54% in Calabria,49% in Sicily and 66% in Lazio) (source: National Civil Protection webpage, update October 2016)	disaster	Providing incentives through legislation or economic support to draw up the plans
The potential effects of Climate Changes are not taken into account in action planning	New artifacts or updating of existing ones (e.g. drainage networks) could not address new needs	Few experiences at urban level for Municipal Adaptation Plans (e.g. Bologna, ancona)	Higher costs for induced hazards, for future updates	KTM 24 Providing incentives (economic or legal) to increase awareness and initiatives about the effect of climate changes
AGRICULTURE (CULTIVATION AND LIVESTOCK FARMING)				
Driving forces	Pressures	State	Impacts	Responses
Use of mineral fertilisers (mainly N consumption)	Diffuse N inputs on/in the soil through runoff and percolation	Values of nitrates above the maximum allowable concentration for drinkable water (50 mg/L)	Impact on human health Unfit for drinking Eutrophication	KTM 2 Optimisation of Nitrate Directive Farming practice regulation Agri-environmental measures
Use of pesticides	Diffuse pesticide contamination from runoff and percolation	Values of pesticides above the maximum allowable concentration	Impact on human health Unfit for drinking and irrigation	KTM 3 Farming practice regulation Agri-environmental measures Support for integrated farming
Inappropriate livestock waste and manure management	Diffuse contamination of pathogens and N into groundwater and soil through leaching	Presence of excess pathogens and N into ground waters and soils	Impact on human health Unfit for drinking and irrigation	KTM 2, KTM 12 Optimisation of Nitrate Directive Support for investments in storage of manure, and training of farmers
Increase of livestock density	Buildups of excess nutrients and heavy metal in the soil.	Values of nutrients and heavy metals concentration above the drinking water standards.	Impact on human health Unfit for drinking and irrigation	KTM 2, KTM 12 Optimisation of Nitrate Directive Support for investments in storage of manure, and training of farmers
Water abstraction for irrigation purposes	Decrease in water table height and land subsidence enhancing sea	Increase of salinity and conductivity above drinking water standards	Over exploitation of water resources Salinization of soils and desertification	(KTM 11), (KTM 8), KTM 7 Investments for improving the state of irrigation infrastructures or irrigation techniques

	water intrusion into aquifers Decrease dilution of salts in ground waters			Water pricing policies Water sources differentiation Desalinization treatments
Excessive or uncontrolled irrigation	Increase runoff of nutrients, pesticides and salts Waterlogging in poor in poorly drained soils enhancing evaporation and salinization	Values of nutrients, pesticide, salinity above the drinking water standards. Increase of salinity and conductivity above drinking water standards	Salinization of soils and desertification Human health	(KTM 11), (KTM 8), KTM 12 Farming practice regulation Agri-environmental scheme Creation of buffer/sink zone for nutrients Water pricing policies
INDUSTRIAL UNITS				
Driving forces	Pressures	State	Impacts	Responses
Lack of industrial effluents treatments systems Accidental/catastrophic discharge	Direct discharge of industrial waste waters into surface bodies	Values of nutrients, metals, salts and priority contaminates concentration for drinkable water	Unfit for drinking and irrigation Water and soil contamination Impact on human health	KTM 15, KTM 21 Implementation of appropriate sewage system and devices for wastewater treatment Optimization of waste management systems and storage
TRANSPORT UNITS				
Driving forces	Pressures	State	Impacts	Responses
Road and parking cleaning and maintenance	Diffuse salts and metals contribution trough runoff and percolation	Values of metals, salts and priority contaminates concentration for drinkable water	Unfit for drinking and irrigation Water and soil contamination	KTM 21 Implementation of appropriate sewage system and devices
FORESTS				
Driving forces	Pressures	State	Impacts	Responses
Uncorrect management (e.g. unregulated cut)	Mobilisation of salts and sediments from subsoil Zone	Increase of salinity and total dissolved solids above drinking waters standards	Unfit for drinking, irrigation and specific industrial uses	KTM 17 Improved management Zonation of land to preserve habitat Increased conservation areas
Fires	Ateration of soil physical, biological and chemical characteristics	Increased water repellency of soil and loose of soil structure	Post-fire increase of runoff and erosion processes that also transport soil contaminants then infiltrating into low slope areas.	KTM 17 Improved management Fire fighting

Impact on floods/droughts				
AGRICULTURE (CULTIVATION AND LIVESTOCK FARMING)				
Driving forces	Pressures	State	Impacts	Responses
Land use change	Reduction of green areas and increase bare soil areas	Reduction of infiltration and evapotranspiration	More flood events during winter time	KTM 6 Construction of the dike system and protection system
Land use change	Reduction of green areas and increase bare soil areas	Increase of evaporation	More drought event during summer time	KTM 6 Construction of modern water supply system
Cultivation intensity	Increase of water consumption/water demand	Decrease water availability	More droughts for the downstream of river networks	KTM 6 Implementation of new irrigation methods (artificial irrigation instead of gravity irrigation) Sustainable soil working (ploughing) to maintain hydraulic properties.
INDUSTRIAL UNITS				
Driving forces	Pressures	State	Impacts	Responses
Expansion of industrial areas	Reduction of green areas and increase of obstacles	Reduction of infiltration and drainage ability of flows	Increase flood events, retention times and inundation deep	KTM 6, KTM 7 Construction of pumping stations which will operate during flood events
Water consumption	Increase water demand for industrial sector	Reduction of water availability on the surface freshwater	Water deficit and droughts for downstream of river networks	KTM 13 Differentiate water supply sources (i.e. freshwater/groundwater)
FORESTS				
Driving forces	Pressures	State	Impacts	Responses
Uncorrect forest management (e.g. unregulated cut, no wood harvest)	Presence of woody debris on hillslopes	Increase of sediment/debris loads on flowing water	Floods due to debris/sediment creating barriers within channels	KTM 17 Improved forest management
Fires	Ateration of soil physical, biological and chemical characteristics	Water repellency of soil and loose of soil structure	Increased runoff and erosion processed that favor overland transport and deposition of sediments within hillospe channels and increase flood risk	KTM 17 Improved forest management Fire fighting

RECREATIONAL SECTOR				
Driving forces	Pressures	State	Impacts	Responses
Growth of recreational sites	Increase of artificial areas, thus, reduction of green area	Reduction of infiltration and drainage ability of flows	Increase of floods events	(KTM 9), KTM 13 Limit growth rate by limit the number of license
Demand of recreational sites	Increase water demand	Reduction of water availability	Increase water shortage and droughts	(KTM 9), KTM 13 Limit water demand by taxes or apply Coase theorem by produce "water rights"
ANTHROPOGENIC				
Driving forces	Pressures	State	Impacts	Responses
Emit GHGs	Increase GHGs in the atmosphere, thus, increase temperature	Snows melt more during winter time; increase of evaporation during summer time	Increase of floods during winter time; increase of droughts during summer time	KTM 24 Limit CO2 emission by national strategy and international volunteer agreement (COP 21)

4. SWOT analysis and evaluation of gaps

WEAKNESSES

- lack of awareness of the existence, relevance and value of groundwater
- the amount of water currently authorized largely outnumbers the real renewable resources from surface waters and ground waters (real abstractions are lower than authorized ones)
- the RBMPs just approved points out several surface water bodies in conditions of quantitative stress for excess of water abstraction; in next years the regulations of minimal streamflow in surface natural water bodies will require a slight decrease of disposable water resource and the implementation of e-flows could introduce more constraints
- not all groundwater protected areas are clearly defined in spatial planning documents
- because of the quite high level of current coverage/efficiency of waste water treatments, further improvements, in terms of more advanced treatments in main plants and little villages or rural houses plants, will be more and more expensive
- chemical status of “transition waters” recognized as “not good” according WFD 2000/60/CE thresholds for large part of Central (80% Northern Apennine) and Southern Italy (75% for Apulia , 100% for Campania Region, 55% for Sardinia) (source: data covering 2010-2016 from 2016 ISPRA Environmental Data Yearbook)
- chemical status of surface waters is not currently monitored for a large part of

STRENGTHS

- the quantitative status of several ground water bodies is good, and there is a positive trend of rising of piezometric levels for several monitoring wells
- some of the two majors regional drinking water supply systems are supplied with either surface water and groundwater, the presence of reservoirs and the redundancy of potential of water treatment plants involves considerable resilience of the supply chain
- in the process of implementation of the RBMP just approved, Emilia-Romagna Region has started a phase of review and rationalization of the abstraction permission of surface and ground water to bring the volume authorized into more appropriate and sustainable quantities
- the new regional law on urban planning (not yet approved) is oriented toward zero rural land use and regeneration processes of urban areas that include environmental protection issues
- chemical status of “transition waters” recognized as “good” according WFD 2000/60/CE thresholds for large part of Eastern Alps (53%) and Venice lagoon (75%) (source: data covering 2010-2016 from 2016 ISPRA Environmental Data Yearbook)
- chemical status of surface waters is recognized as good for a large part of river and lakes in North-Central Italy (e.g. about 85% for Eastern Alps, 70% for Central Apennine)
- chemical monitoring of groundwater is

water bodies in Southern and Insular Italy (source: 2016 ISPRA Environmental Data Yearbook).

- chemical status of ground waters is recognized as "not good" according 2000/60/CE Directive thresholds for about 35% of water bodies (about 42% in terms of surfaces); much worse values are found at regional scale for Lombardy (85%) and Apulia (78%)
- monitoring system of water quality is quite limited, mostly concentrate on the Northern part (ISPRA, 2016)
- negligible percentage of wastewater directly reused (sometimes wastewater discharged in rivers and canals is abstracted for irrigation)
- the potential effect of climate changes and not adequate land use planning can exacerbate flood risk due to complex geomorphological features and weather patterns typically affecting some part of Italian territory
- areas without sewage system
-

currently carried out with measuring campaigns characterized by continuous improvement and definition and financed by programs and Monitoring networks (surveillance and operational) to properly fulfill targets established by European Directives 2000/60/EC and 2006/118/EC. The first cycle was finished in 2015.

- according index about groundwater quantitative (Directive 2000/60/CE), about 85% groundwater bodies are in "good" conditions.
- the administrative capacity for effective (ground)water management is significant
- in the process of drawing up the RBMPs, synergies / conflicts between Water Directive and flood Directive have been analyzed

OPPORTUNITIES

- to use of EU funds, particularly structural and cohesion funds for co-financing (ground)water projects
- to start with realization of interdisciplinary scientific project on valuation of groundwater resources and ecosystem services
- trends of industrial water abstractions in the last forty years show a progressive and continuous reduction; future trends will very likely remain in slight decrease
- trends of civil water abstractions in the last forty years show a progressive increase until year 2000, and then a substantial stability because of a significant reduction of pro capita water consumption; for the future there are

THREATS

- climate changes could affect frequency and magnitude of extreme events with consequent increases in urban flooding and drought events
- climate changes could affect seasonal patterns of hydrological cycle with different features at local scale inducing issues in water availability and quality
- other sectorial (national) strategies (i.e. energy) are not harmonized with water management strategies (i.e. incentivizing thermoelectric plants fueled with highly water demanding biomasses)
- the impact of climate change and changes in land use on water resources is strongly linked to the agricultural land use (cultivation practices and, mostly,

prospects for further invariance of needs, or even a slight decrease in the case of improvement of the efficiency of networks and plants ▪ enable a better communication between scientists-professionals and local actors and improve the transfer of results to decision makers and authorities responsible for the implementation of European directives ▪ to build interdisciplinary research topics with significant stakeholders in the region in order to meet the transboundary (ground)water policy and (ground)water management needs ▪ to develop efficient education system for public water management administration in cooperation with decision-makers, legislators, NGOs and research institutions ▪ to initiate better communication and dissemination of knowledge and experience between decision-makers and legislators and water scientists and experts working on national or international scientific or professional (ground)water projects ▪ implementation of the measures defined in the Water Framework Directive (compliance with environmental objective, monitoring of surface water and groundwater) ▪ implementation of good practice for maintenance of biodiversity, landscape, soil protection and water resources (Recovery of local varieties with lower water consumption, Adaptation measures to climate change, Improving irrigation efficiency, Ensure compliance with Water Framework Directive) ▪ government mission structure against geo-hydrological risk and for	crops grown); until now the choice of crops grown and cultivation practices is a free option of farmers, thus hardly predictable for the future ▪ causes of adverse change in quantitative and qualitative characteristics of groundwater are not fully identified or understood, improvement of quantitative and qualitative status by management measures requires long times ▪ trends of irrigation water abstractions in the last forty years show a progressive increase, because of irrigated area increase and, in the last years, of the global warming; future scenarios envisage a substantial increase of crops irrigation needs ▪ lack of investment in water service infrastructures due to the economic crisis and to the lack of clarity, even in legal rules, on financing methods (rate of costs recovering, remuneration of wastewater service provider) ▪

	development of Hydraulic Infrastructure attempts providing a rationale programming for priorities and investments	

5. Progresses in implementation of WFD for Italy

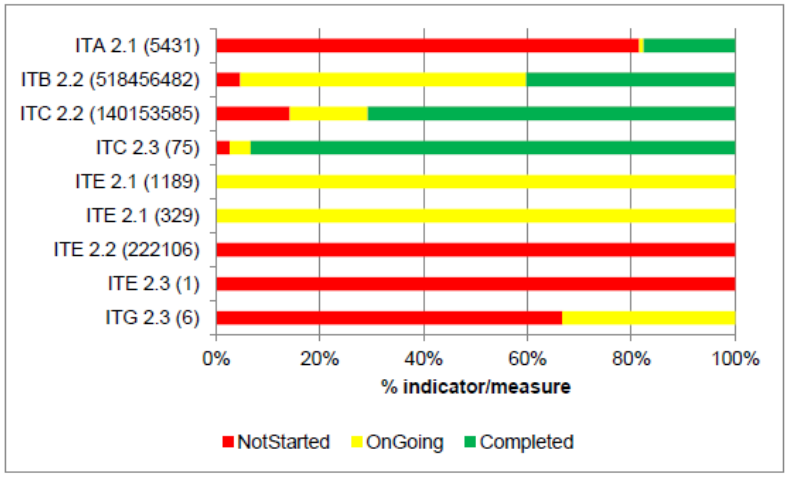
The progresses in implementation of the WFD programmes of measures are summarised in National Country Reports referring to Key Types of Measures (KTMs). In the specific, the identified 16 KTMs are "expected to deliver the bulk of the actions required to achieve WFD objectives, i.e. to reduce significant pressures to the extent required to achieve good status or to prevent deterioration of status in high and good status water bodies" (WRC PLC, 2015). Among these ones, the results about the nine identified as more relevant for PROLINE-CE Project are reported in the following. To this aim, first, it could be useful also to recall the eight River Basin Districts (RBDs) covering the Italian territory:

Table 4. River Basin districts (source WISE Water Information system for Europe)

RBD	Name	Size (km2)	Countries sharing RBD
ITA	Eastern Alps	40851	AT,CH,SI
ITB	Po Basin	74000	CH,FR
ITC	Northern Appenines	38131	FR
ITD	Serchio	1565	-
ITE	Middle Appenines	36302	-
ITF	Southern Appenines	68200	-
ITG	Sardinia	24000	-
ITH	Sicily	26000	-

Figure 2. Maps of Italian River Basin districts

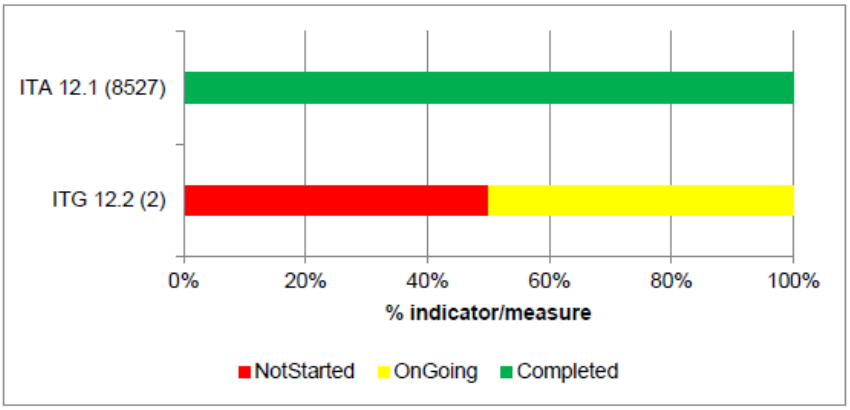
5.1. Progress with implementation of measures to reduce pressures (nutrients, organic matter) from agriculture



Key to indicators:
The annotations next to each bar in the Figure shows "RBDCode: Indicator number: (value of the indicator when 100% completed)":
2.1 Area of agricultural land covered by measures (km^2) beyond the requirements of the Nitrates Directive in this case agricultural land covered by General Binding Rules
2.2 Estimated Total Costs (€) of the measures
2.3 Number of projects/measures
Source: WISE PoM Reports

Figure 3. KTM2: Reduce nutrient pollution in agriculture beyond the requirements of the nitrates directive [relevant for PROLINE-CE Project]

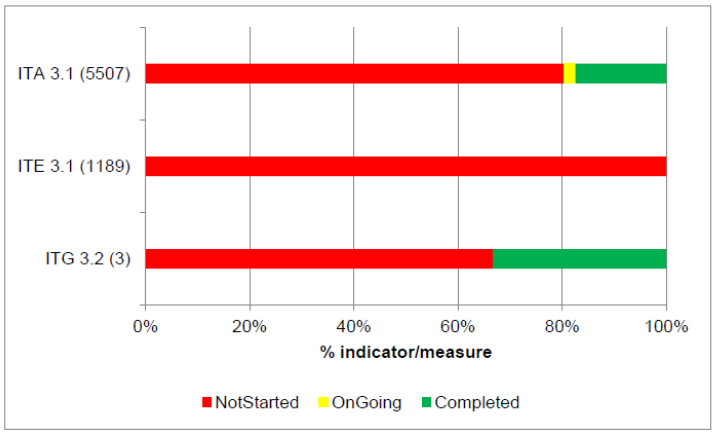
(PoM stands for Programme of Measures)



Key to indicators:
The annotations next to each bar in the Figure shows "RBDCode: Indicator number: (value of the indicator when 100% completed)."
12.1 Number of farms
12.2 Number of advisory services
Source: WISE PoM Reports

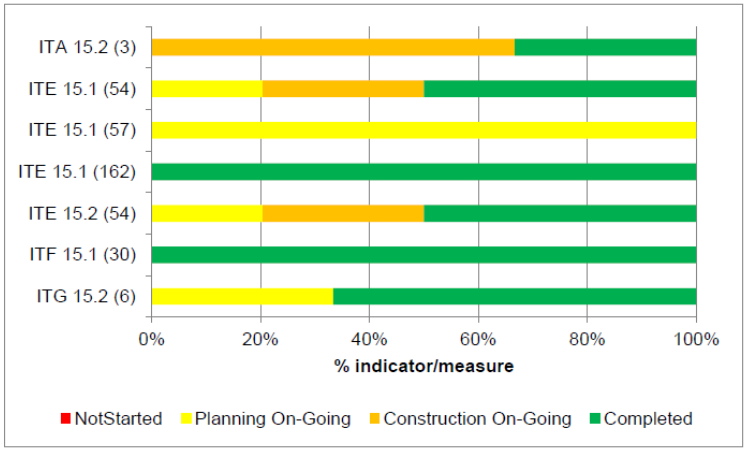
Figure 4. KTM12: Advisory services for agriculture [relevant for PROLINE-CE Project]

5.2. Progress with implementation of measures to reduce pressures from chemicals



Key to indicators:
The annotations next to each bar in the Figure shows "RBDCode; Indicator number; (value of the indicator when 100% completed)":
3.1 Area of agricultural land covered by measures (km^2) to reduce pollution in agriculture
3.2 Number of projects/measures
Source: WISE PoM Reports

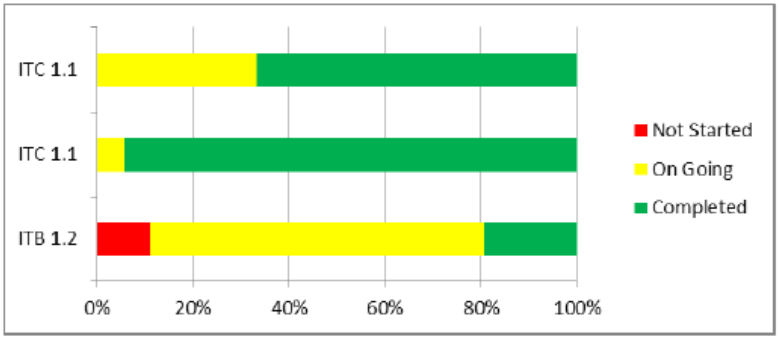
Figure 5. KTM3: Reduce pesticides pollution in agriculture [relevant for PROLINE-CE Project]



Key to indicators
The annotations next to each bar in the Figure shows "RBDCode: Indicator number: (value of the indicator when 100% completed)":
15.1 Number of permits issued or updated
15.2 Number of projects/measures

Figure 6. KTM15: Measures for the phasing-out of emissions, discharges and losses of priority hazardous substances or for the reduction of emissions, discharges and losses of priority substances [partly relevant for PROLINE-CE Project]

It is also associated to KTM15, a further indicator:

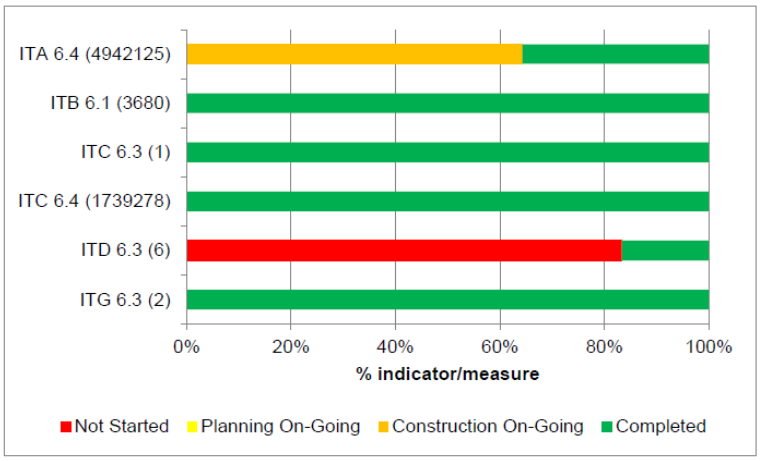


Key to indicators measures
The annotations next to each bar in the Figure shows "RBDCode; Indicator number"
1.1 Water efficiency measures for drinking water (Water quantity)
1.2 17
Source: WISE PoM Reports

Figure 7. Status of measures

(at the moment, it is not clear as the same indicator is reported twice in different ways for ITC]

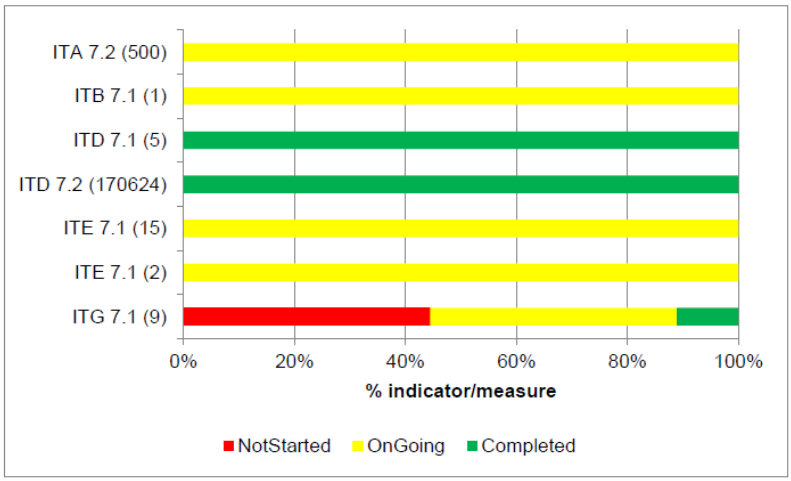
5.3. Progress with implementation of measures to reduce pressures from hydromorphological alterations



Key to indicators
The annotations next to each bar in the Figure shows "RBDCode; Indicator number; (value of the indicator when 100% completed)":
6.1 Length of rivers (km) affected by measures
6.3 Number of projects/measures
6.4 Estimated Total Costs (€) of the measures
Source: WISE PoM Reports

Figure 8. KTM6: Improving hydromorphological conditions of water bodies other than longitudinal continuity [partly relevant for PROLINE-CE Project]

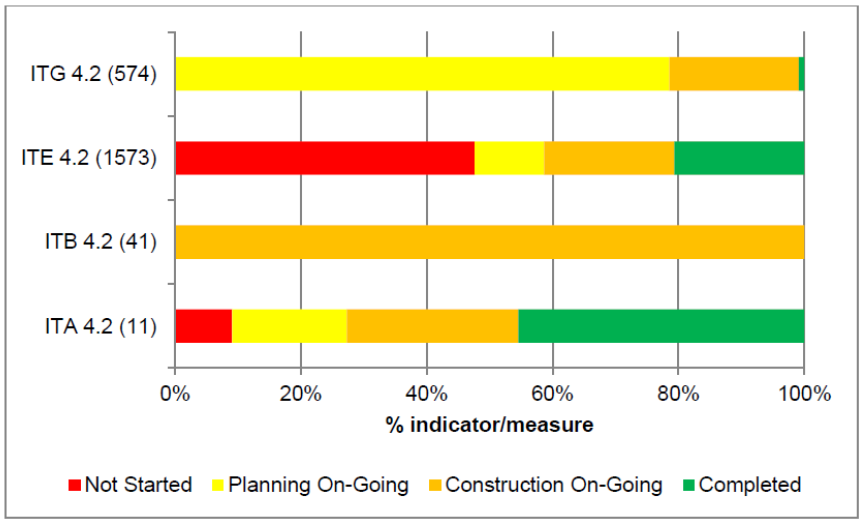
5.4. Progress with implementation of measures to reduce pressures from water abstractions



Key to indicators measures
The annotations next to each bar in the Figure shows "RBDCode; Indicator number; (value of the indicator when 100% completed)"
7.1 Number of projects/measures (including permits)
7.2 Length of rivers (km) affected by measures
Source: WISE PoM Reports

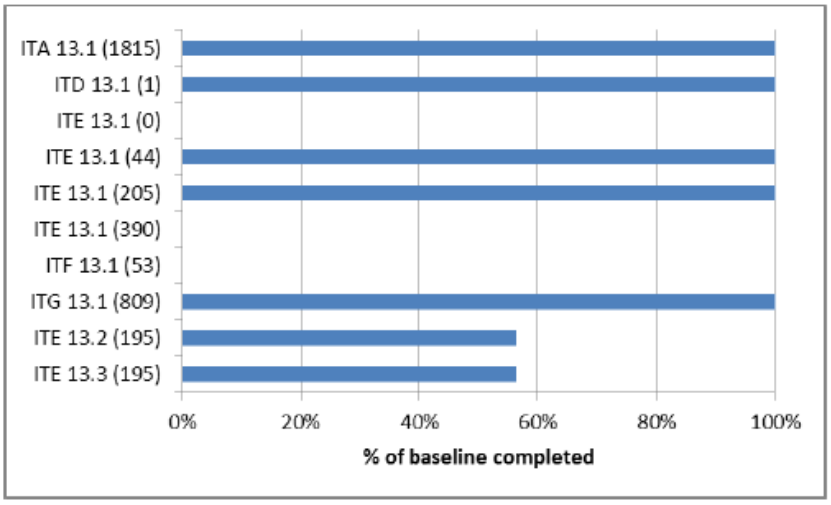
Figure 9. KTM7: Improvements in flow regime and/or establishment of minimum ecological flow [partly relevant for PROLINE-CE Project]

5.5. Reporting of other Key Types of Measure



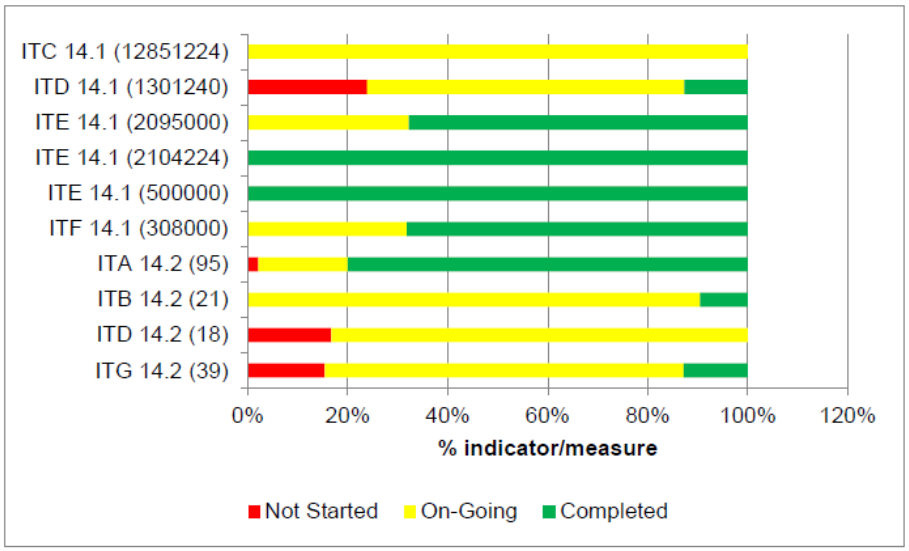
Key to indicators measures
The annotations next to each bar in the Figure shows "RBDCode; Indicator number; (value of the indicator when 100% completed)"
4.2 Number of sites subject to measures
Source: WISE PoM Reports

Figure 10. KTM4: Remediation of contaminated sites (historical pollution including sediments, groundwater, soil) [partly relevant for PROLINE-CE Project]



Key to indicators measures
The annotations next to each bar in the Figure shows "RBDCode; Indicator number; (value of the indicator when 100% completed)"
13.1 Number of drinking water protection zones
Source: WISE PoM Reports

Figure 11. KTM13: Drinking water protection measures (e.g. establishment of safeguard zones, buffer zones, etc.) [relevant for PROLINE-CE Project]



Key to indicators measures
The annotations next to each bar in the Figure shows "RBDCode; Indicator number; (value of the indicator when 100% completed)"
14.1 Estimated Total Costs (€)
14.2 Number of the research studies etc.
Source: WISE PoM Reports

Figure 12. KTM14: Research, improvement of knowledge base reducing uncertainty [partly relevant for PROLINE-CE Project]

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