Istat
Istituto Nazionale di Statistica

**Social and Environmental Statistics Department**
**Socio-demographic and Environmental Statistics Directorate**
**State of Environment Division**
**Water resources and climate Unit**

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# Statistics on water resources, water use and wastewater treatment – "Development of data collections systems and statistical methods for indicators at the sub-national level"

*final report*

# SUMMARY

# ACRONYMS

ATO = Optimal Management Areas

$BOD_5$ = Biological Oxygen Demand

CRA-CMA = National Agricultural Research Council - Research Unit for Climatology and Meteorology applied to Agriculture

DEM = Digital elevation model

E = Actual Evapotranspiration

Et0 = Potential Evapotranspiration

GIS = Geographic Information System

HSG = Hydrologic soil groups

IGM = Military Geographic Institute

IRSA-CNR = Water Research Institute - National Research Council

ISPRA = Institute for Environmental Protection and Research

KED = Kriging with External Drift

JQ – IW = Joint Oecd/Eurostat questionnaire Inland Waters

MLR = Multiple Linear Regression

NUTS = Nomenclature of Territorial Units for Statistics

REQ = Regional Environmental Questionnaire

RBD = River Basin District

USGS = United States Geological Survey

UTM = Universal Transverse Mercator coordinate system

WGS84 = World Geodetic System 1984

WMO = World Meteorological Organization

# INTRODUCTION

## Goals and objectives

The Italian National Institute of statistics (Istat) joined the Call for Eurostat Grants 2010 “Statistics on water resources, water use and wastewater treatment” with the aim to calculate, for the first time, some of the indicators required in the OECD-Eurostat Joint questionnaire Inland Water and in the Eurostat Regional Environment Questionnaire, both at national and sub-national level.

The title of the Grant project is: “Development of data collection systems and statistical methods for indicators at the sub-national level (NUTS-2 Region, River Basin Districts) in Italy”.

The action run for 24 months, starting from 1 January 2011.

The group involved is the Istat’s “Water resources and climate Unit” and the project leader is Stefano Tersigni.

Synthetically, the main objectives have been to:

- improve data quality on water statistics in Italy;
- grow indicators availability in order to better fill in the REQ and IW-JQ questionnaires;
- better meet the growing international and national data needs;
- develop a cooperation net between data producers and stakeholders in order to make better data collection and production;
- define more relevant indicators for end users.

In detail, the indicators produced have been:

1. Freshwaters resources - At national, regional and river basin district level, yearly (since 2001 to 2010) and long term average (1971-2000):
   - precipitation;
   - actual evapotranspiration;
   - internal flow;
   - actual external inflow;
   - total actual outflow;
     of which: into the sea;
     of which: into neighbouring territories.

2. Annual fresh groundwater and surface water abstraction for public water supply at national, regional and RBD level, years 2005 and 2008

3. Total public water supplied, years 2005 and 2008

4. Treatment capacity of wastewater treatment plants by national and regional (NUTS2) level, years 2005 and 2008

5. Generation and discharge of wastewater by national and regional (NUTS2) level, years 2005 and 2008

## Spatial aggregation

The level of spatial aggregation, as requested in the questionnaires, has been Regions (NUTS 2) and River basin districts (RBD), as recently set up under the European Framework Directive 2000/60/EC. In Italy eight RBD have been defined.

Since regional limits are well defined, as they represent administrative boundaries, the analysis by region did not present problems, except in some cases - that will be described below – where the nature of the physical variable was hardly suitable for administrative boundaries.

Differently, for RBD the initial difficulty has been to define their geographical limits, since in Italy there was not an official cartography. Through different methods, described in the following paragraphs and in agree with the various competent authorities, the boundaries of the RBD have been defined.

In addition to the complexity coming from the lack of an official cartography at RBD level, a problem to resolve has been the translation of the information at RBD level when indicators are referred to administrative limits, for example for the water supplied, that is collected at municipal level. To obtain this result, the problem of the municipalities overlap has been taken into account. The methodology used analysed data at enumeration area level. As a section census can belong to different RBD, each enumeration area has been assigned to an exclusive RBD on the basis of the prevalent surface. For each area the correspondent and exclusive RBD, on the basis of prevalent surface, has been determined.

## Grant scheduling

The first year of the project has been dedicated to:

- prepare the databases necessary to calculate indicators;
- define the boundaries of RBD.

On 26 January 2012 an Interim report was sent to Eurostat with the aim to describe the first year of activity.

During the Working group on “Water statistics” (Luxembourg, 1-2 February 2012) a short presentation of the Italian pilot project has been shown.

In addition, during the following Working group on "Water statistics" (Luxembourg, 13 may 2013) some of the major results of the project have been illustrated.

At the end of the Grant period, with some months of delay communicated to Eurostat Staff, Istat has produced the indicators expected at the end of the project. They have been sent in conjunction with the dissemination of the REQ and JQ - IW 2012.

Data released for each questionnaire are shown below.

For the REQ data collection "Inland Water":

- Table 1.1.R - Renewable freshwater resources by RBD
- Table 1.1.N - Renewable freshwater resources by NUTS2
- Table 1.2.R - Total gross water abstraction and water losses by source - by RBD
    - Fresh surface water – of which Public water supply
    - Fresh groundwater – of which Public water supply
- Table 1.2.N - Total gross water abstraction and water losses by source - by NUTS2
    - Fresh surface water – of which Public water supply
    - Fresh groundwater – of which Public water supply
- Table 1.5.N - Treatment capacity of wastewater treatment plants - by NUTS2
- Table 1.6.N - Generation and discharge of wastewater - by NUTS2
    - BOD - Wastewater Treatment and Discharge - Wastewater treated in WWTP

For the JQ - IW:

- Table 1 - Renewable freshwater resources
- Table 1_IF - Actual external inflow from neighbouring territories
- Table 1_OF - Actual outflow to neighbouring territories
- Table 2: Annual freshwater abstraction by source and by sector
    - Fresh surface water – of which Public water supply
    - Fresh groundwater – of which Public water supply
    - Total surface and groundwater – of which Public water supply
- Table 3: Water made available for use
    - Desalinated water – of which Public water supply
- Table 4a: Water use by supply category and by sector

- Public water supply – Total

- Table 6: Treatment capacity of wastewater treatment plants, in terms of $BOD_5$
  - Urban Wastewater Treatment
    - Total treatment (Plants and Incoming $BOD_5$)
    - Primary treatment (Plants and Incoming $BOD_5$)
    - Secondary treatment (Plants and Incoming $BOD_5$)
    - Tertiary treatment - Total (Plants and Incoming $BOD_5$)

Data have been transmitted to Eurostat by eDamis protocol (for the REQ questionnaire, on 16 July 2013) and mail (For Inland Water questionnaire, on 23 July 2013). Data related to wastewater will be sent in conjunction with the transmission of the final report.

The check and validation of other indicators is still in progress. At the end they will be sent to Eurostat.

# CHAPTER ONE - RENEWABLE FRESHWATER RESOURCES

## Introduction

In the next paragraphs an in-depth methodological analysis about Renewable freshwater resources is described in order to explain methodological steps to fill in, for the first time, the following tables.
For the REQ data collection "Inland Water":

- Table 1.1.R - Renewable freshwater resources by RBD;
- Table 1.1.N - Renewable freshwater resources by NUTS2.

For the JQ - IW:

- Table 1 - Renewable freshwater resources;
- Table 1_IF - Actual external inflow from neighbouring territories;
- Table 1_OF - Actual outflow to neighbouring territories.

First of all a description of the Italian territory and its peculiarities is fundamental to understand the complexity of this work.

After a necessary preamble about the state of the storage in Italy for meteorological and hydrological data, the steps carried out to obtain data necessary to calculate the indicators requested in the Eurostat questionnaires are described.

To finish, for each indicator present in the tables listed above, methodological choices and some results are shown.

## The Italian territory and its peculiarities

The peculiar geologic, climatic and land use aspects influence, in Italy, water resources distribution. Climatic conditions are mainly affected by land morphology. Beyond being a peninsula, which determines an extension of coasts for 7,456 kilometres, Italy is characterised by mountainous and hilly chains developed along the whole country.

Italy is included in a climatic transition zone encompassing the European continental zone and the Mediterranean region. In the northern side of the borderline, precipitation appears to be more concentrated in high intensity events. In the southern side of this borderline, a lower degree of precipitation is, on average, observed, with a tendency towards long periods of drought. Annual precipitation and temperature patterns are thus mainly determined by latitude and elevation.

It is known that rainfall might have different destinations, such as evaporation, runoff and deep infiltration, depending on geologic characteristics, land morphology, rainfall trend and intensity.

As regards the Italian river network, unlike France and Germany dominated by a few big watercourse with regular flow, northern Italian regions are characterised by big river systems (such as Po, Adige, Piave, Tagliamento, Brenta-Bacchiglione), mainly with regular flow, coming from Alps and flowing into the Adriatic sea. Instead, in peninsular Italy the drainage networks are more limited and show seasonal irregular flows, with the exception of Tevere, Arno, Liri-Garigliano and Volturno rivers.

The availability of water resources is also determined by land use. The role of agriculture on land has been recently recognised. In fact, agriculture has shaped the landscape in order to cultivate areas with different morphological (slope, plain, etc.) and climatic conditions, even in areas characterised by extreme climatic events such as flooding or drought. Referring to water resource availability, soil tillage for crop cultivation allows a high rainfall infiltration, thus increasing soil water storage and ground water recharge. At the same time agriculture is one of the most water demanding human activity. The distribution of agricultural activity among the country underlines both problems of water management and water requirement. Agriculture is the most land consuming human activity, being conducted over 44 percent of the national territory.

## A necessary preamble: the state of meteorological and hydrological data storage in Italy

There are several institutions that, in Italy, are engaged in water resources management and monitoring: Italian Ministry of the Environment, Regions, Provinces and River Basin Districts authorities.

It’s clear, therefore, that different institutions are involved in this matter and the related functions are split up between a high number of territorial authorities and managing firms.

Also meteorological data are in charge of several institutions, creating a problematic situation for all researchers that would like to know and analyse data related to the Italian climate conditions and in general to the resource “water”.

The lack of an official institution that check the whole meteorological and hydrological data at national level produces, therefore, low homogeneity and standardization.

## Database implementation

As is known, for a detailed study of the spatial variability of climatic and hydrological variables a sufficient number of data distributed all over the territory, with a reliable quality, is needed. Therefore it is important, during the implementation of a database, to ensure the reliability of the data, in addition to their acquisition. It is also important and fundamental to check the location of the points on the national territory with the assessment of the coverage.

As mentioned previously, in Italy there is not a national database related to termo-pluviometric and hydrological data, so – during the first step of the project - Istat proceeded with the implementation of a geographical data-warehouse with meteorological, agro-meteorological and hydrological daily values provided by more than 600 national, regional and local institutions operating in the meteorological field. This geo-database has been developed in ORACLE/ARCGIS environment in order to properly store collected time series data of all the climatic variables.

This activity has been included in the Istat research project "Meteo-climatic and hydrologic indicators" started in 2007 and written in the National Statistical Program (2008-2010).

Meteo-climatic data used in the project, all registered in a daily format, are precipitations and temperature (minimum and maximum). For the hydrometric stations the variable analysed is the water flow.

The first step has been to collect data coming from several institutions referred to the period 1950-2010.

The coexistence of different metadata and system collections made the data base development more complicated.

All this data have been homogenized and loaded in two tables (meteorological and hydrological ones), with the aim to compare data. Later, data have been converted in the same format and in the same measurement unit. An univocal code has been assigned to each gauging station.

Among the others, one of the more complicated problem to resolve has been that, in some cases, data format are still on paper, especially for the oldest time series data. These data have been digitalized.

A process of checks (WMO, 1993; 2008; 2010; 2011), reviews and corrections has been carried out with the aim to make data reliable; the unsolvable situations have been deleted.

The altitude and the geographic coordinates of each gauging station have been checked, standardized and validated, with a spatial analysis (in ArcInfo™ environment) overlapping point shapefile, coming from many carthographic sources at different scale, on IGM maps at scale 1:25.000, on CTR (Regional technical map) at scale 1:10.000, on DEM at 20 meters resolution or over orthophotos. In doubtful cases, further checks with the experts of the Institute of competence have been done.

A process of homogenization has been applied to the geographical coordinates, in order to express all of them all expressed in UTM zone 33 with datum WGS84.

Numerous cases of overlapping stations have been highlighted after the identification of the location and altitude of each station; then, a process of cross-comparison between the metadata (coordinates and altitude) and data has been made. The superposition of several stations at the same time has offered the possibility to integrate and compare data for a better guarantee of reliability.

For the hydrometric gauging stations further corrections of information related to geographic and morphological features (distance from the mouth, basin area, ...) have been also carried out, using information available in literature or through GIS methodology.

Meteorological stations detected are 6215 (Figure 1), while the hydrometric ones are 955 (Figure 2). For this work about one hundred of gauging stations have been used to validate the spatialized data, while 158 hydrometric stations (Figure 3) have been used to have the flow measurement at the end of each basin.

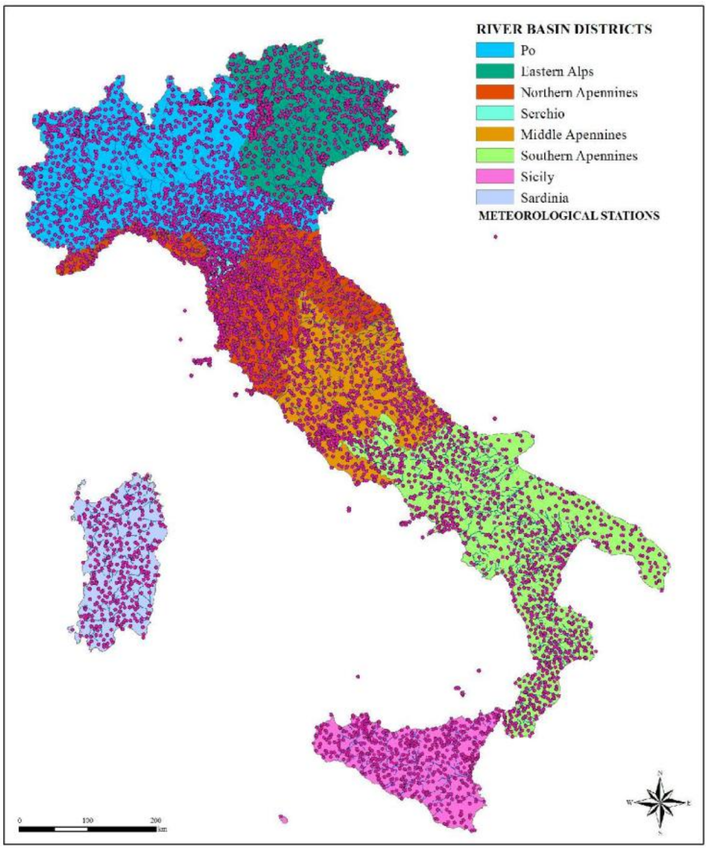



**Figure 1: Meteorological stations and river basin districts**


**Figure 2: Hydrometric gauging stations**


**Figure 3: Hydrometric gauging stations near the mouth**

## Meteorological data sources

For the period 1971-2010 have been used values of temperature and precipitation, stored in the National Agro-Meteorological Database of the Italian Ministry of Agriculture, Food and Forestry and spatialized with stochastic methods, on a regular grid of 0,1° to the side (3.193 knots) generated through procedures of geostatistics spatial analysis (Figure 4).

In detail, the reconstruction of pluviometric fields has been estimated with a stationary model (Ordinary Kriging); whereas thermometric fields have been reconstructed with the non-stationary model (Universal Cokriging), where the drift is defined by elevation and forecast fields processed by a numerical limited area model (DALAM-III) of the same variables and days (Buzzi et al., 2006; Libertà et al., 2008).

Both for temperature and precipitation, the geostatistical analysis has been based on data coming from about 200 gauging stations at ground-level, equally distributed along the territory and belonging to National meteorological networks (RAN network - CRA-CMA, UGM network of the Meteorological Service –Italian Air Force , ENAV network - National Agency for Flight Assistance), and to some regional networks.

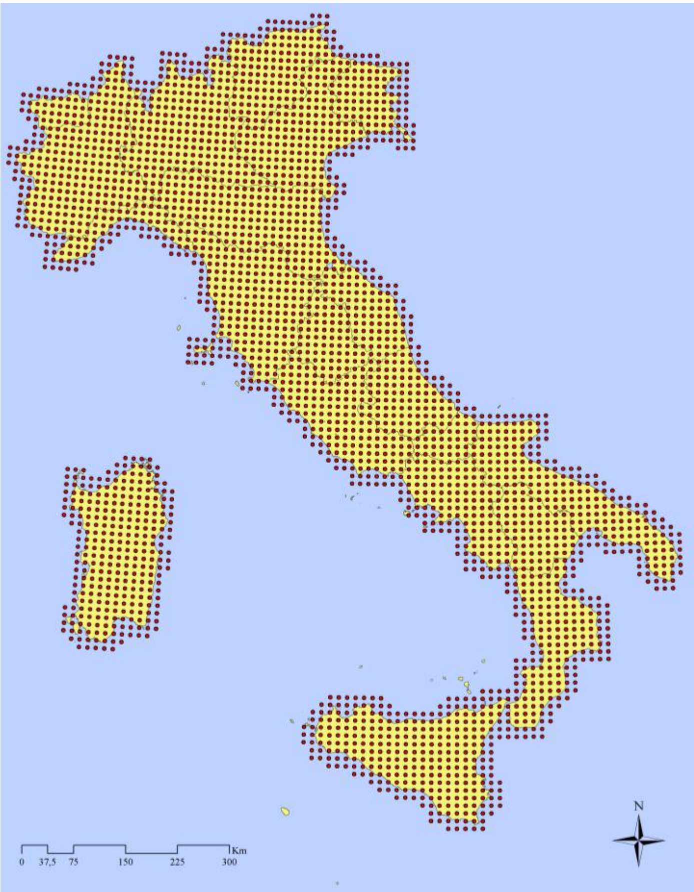



**Figure 4: Grid dataset**

Data have been submitted to quality controls checks, spatial and temporal congruence, outliers identification and location and count of missing values. In no case missing data have been replaced (WMO, 1993; 2008; 2010; 2011).

The adequacy of the geostatistical models adopted has been estimated with a cross validation procedure. Specifically, the daily temperature and precipitation data have been estimated by each method for 83 stations stored in Istat database and not included in the model's dataset, and then compared with the observed values. The results of the comparison between estimated and observed daily values are described in Table 1. The Universal Cokriging method provided the daily average RMSE of about 2°C for both temperatures. Additionally, there is also a small over-estimate of the minimum temperatures and an under-estimate of the maximum temperatures and precipitations.

**Table 1 : Results of the cross-validation**

| Var | Year | Elevation class | Stations (n.) | Average | | | | | Standard deviation | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Rmse (1) | Mae (2) | Crm (3) | Me (4) | $R^2$ (5) | Rmse (1) | Mae (2) | Crm (3) | Me (4) |
| **Tn** | 2000 | < 200 | 25 | 2.49 | 2.10 | -0.09 | -0.16 | 0.85 | 0.87 | 0.80 | 0.17 | 0.92 |
| | | 200 - 400 | 14 | 2.35 | 1.96 | -0.01 | -0.17 | 0.84 | 1.00 | 0.93 | 0.20 | 1.00 |
| | | > 400 | 18 | 2.56 | 2.14 | -0.09 | -0.03 | 0.86 | 0.62 | 0.60 | 0.35 | 0.49 |
| | 2008 | < 200 | 11 | 2.18 | 1.78 | -0.12 | 0.47 | 0.91 | 0.69 | 0.62 | 0.14 | 0.24 |
| | | 200 - 400 | 12 | 2.58 | 2.18 | -0.20 | 0.11 | 0.88 | 0.96 | 0.90 | 0.25 | 0.61 |
| | | > 400 | 13 | 2.28 | 1.85 | -0.04 | 0.35 | 0.88 | 0.58 | 0.52 | 0.34 | 0.30 |
| **Tx** | 2000 | < 200 | 25 | 2.54 | 2.12 | 0.05 | 0.00 | 0.90 | 0.97 | 0.88 | 0.07 | 0.97 |
| | | 200 - 400 | 14 | 2.59 | 2.11 | 0.05 | 0.31 | 0.91 | 0.89 | 0.88 | 0.07 | 0.35 |
| | | > 400 | 18 | 2.81 | 2.31 | 0.04 | 0.15 | 0.90 | 0.77 | 0.73 | 0.07 | 0.52 |
| | 2008 | < 200 | 11 | 2.49 | 2.09 | 0.07 | 0.45 | 0.94 | 0.99 | 0.94 | 0.06 | 0.32 |
| | | 200 - 400 | 12 | 2.44 | 1.97 | 0.05 | 0.38 | 0.91 | 0.94 | 0.80 | 0.07 | 0.70 |
| | | > 400 | 13 | 2.34 | 1.83 | 0.06 | 0.57 | 0.92 | 0.70 | 0.59 | 0.06 | 0.24 |
| **Rr** | 2000 | < 200 | 25 | 5.70 | 1.88 | -0.16 | | 0.27 | 2.95 | 0.54 | 0.46 | |
| | | 200 - 400 | 14 | 6.55 | 1.97 | -0.34 | | 0.16 | 5.76 | 0.94 | 0.84 | |
| | | > 400 | 19 | 8.23 | 2.83 | 0.19 | | 0.30 | 4.95 | 1.54 | 0.25 | |
| | 2008 | < 200 | 16 | 5.18 | 1.98 | 0.03 | | 0.42 | 1.54 | 0.65 | 0.22 | |
| | | 200 - 400 | 18 | 6.79 | 2.63 | -0.01 | | 0.39 | 1.77 | 0.74 | 0.42 | |
| | | > 400 | 16 | 9.93 | 3.37 | 0.32 | | 0.25 | 4.18 | 1.17 | 0.21 | |

(1) Rmse - Root mean square error (2) Mae - Mean absolute error (3) Crm – Residual mass coefficient (4) Me – Nasch Sutcliffe efficiency index (5) $R^2$ - Coefficient of determination.

For each knot, climatic values have been aggregated monthly, evaluating the weight of missing values, and it has been requested a minimum of 70% of non-missing daily values to calculate monthly values.

A geo-database has been built. Each climatic variable (mean temperature of maximum (Tx), mean temperature of the minimum (Tn) and summarised precipitation (Rr)), is represented from 12 layers of information (thematique maps) related to the 1971-2000 (LTAA) and 120 total layers of information for the years 2001-2010.

## River basins

In the first article of the "Regulations for the organizational and functional rearrangement of the soil conservation" (Law of 18 May 1989, no. 183) the river basin has been defined as: "The territory from which the rain water or melting snow and glaciers, flowing out at the surface, are collected, directly or through affluent, in a flow, as well as the area that can be flooded by the waters of the same flow, including its terminal branches with the mouths in the sea and the overlooking coast; if a territory can be flooded by the waters of several flows, it means falling in the catchment area whose mountain catchment basin has the largest surface".

The river basin is bounded by the watershed, defined as the highest line separating the catchments basin and the neighbouring ones.

It is necessary to distinguish the hydrographical basin from the hydrogeological one, in fact the first one is bounded by surface watershed limits, while the hydrogeological one by underground watershed, so as to collect water in the subsoil and, therefore, can be also very different in size and shape from the hydrographical basin.

In this work all basins have been defined in ArcInfo™ environment, with coordinate system WGS84 zone 33 datum WGS84, starting from the basins located by ISPRA and implementing them in the mouth areas and along the watershed limits by comparison with the catchment areas defined by official authorities. 183 river basins have been identified, of which 12 are foreign, but belonging to Italian RBD. A lot of minor neighbouring river basins have been grouped together in order to simplify the calculations, while the basins of major rivers have been divided to better characterize their morphological and weather-climate features. The Adige river basin has been divided in two parts (North and South Adige); the Po river basin in five parts (North-East, North-West, South-East, South-West and Po at the mouth); the Arno river basin in two parts (High and Low Arno) and the Tiber river basin in three parts (High Tiber, Medium Tiber and Tiber at the mouth). Each basin has been identified by a unique identification code, a surface and a perimeter. All indicators under consideration have been calculated for each basin.

## Curve Number method

For the rivers for which no hydrometric gauging stations were available, the volumes have been calculated estimating the runoff of each basin using the empirical method based on the Curve Number, developed by USDA Natural Resources Conservation Service (USDA – NRCS, 1993; 2004).

The runoff has been estimated in initial mean situations of soil moisture, corresponding to the Class (II) of AMC (Antecedent Mixture Condition), and fixing starting coefficients $\beta$=0.2 and $S_0$=254.

The different attitude of soils to produce runoff has been deduced from the reclassification of the hydrogeological complexes in the four groups identified by the NRCS (A - D), generating a thematic map of the hydrologic soil groups in Italy (Figure 5). The layer of hydrogeological complexes used in this work is produced by ISPRA, and it is available as a thematic map in a vectorial format (ESRI shape) (Table 2).

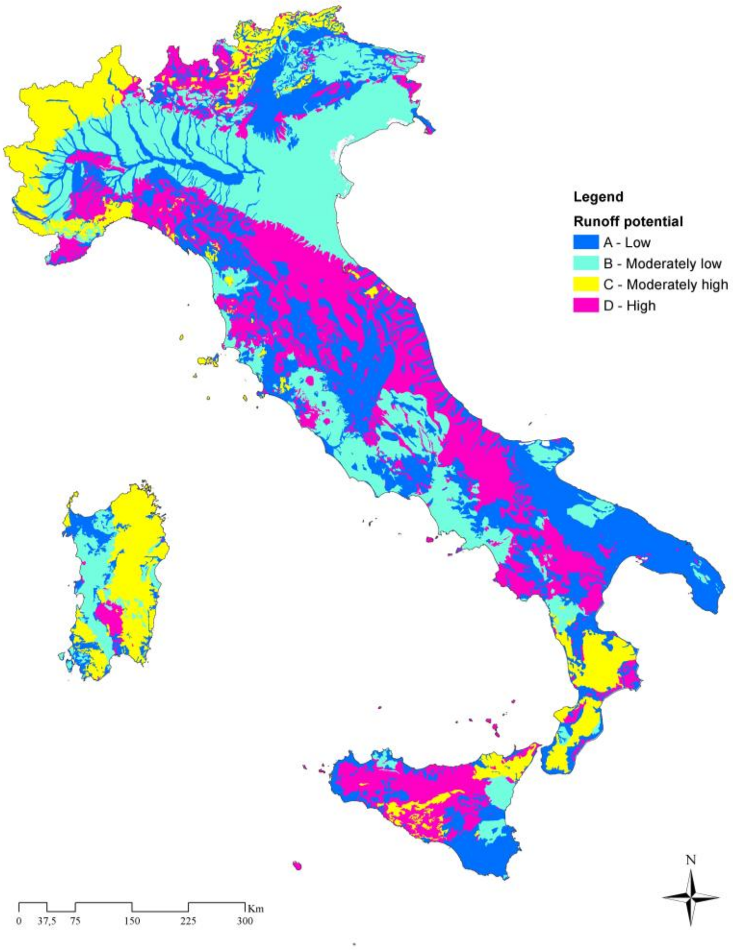



**Figure 5: Hydrologic soil groups (NRCS-USDA)**

**Table 2: Hydrogeologic complex assigned to hydrologic soil groups**

| Hydrogeological complex | Hydrologic soil group |
|---|---|
| Fluviatile deposits of major streams | A |
| Sands complex | A |
| Calcareous rock complex | A |
| Undifferentiated complex of the Pianura Padano Veneta | B |
| Multilayer complex of the Pianura Padano Veneta | B |
| Volcanic rock complex | B |
| Calcareous-dolomitic rock complex | B |
| Mixed sedimentary series complexes | B |
| Perithyrrenian basin fill alluvial complexes | B |
| Evaporite complex | C |
| Crystalline rock complex | C |
| Impermeable rock complex | D |
| Flysh complex | D |
| Lakes | D |

Depending on the type of ground cover, it has been made reference to the classification made under the Corine Land Cover project (CLC06 - Level IV), by aggregating the different types of land use into larger classes.

In Table 3 CN values, assigned to the different categories of land use for each of the 4 hydrological groups, are reported. Through tools of overlay in ArcInfo™ environment, the land use layer has been intersected with the layer of soil hydrological groups, thus obtaining a map of CN for Italy (Figure 6), (Ravazzani G., 2004; USDA-NRCS, 2007).

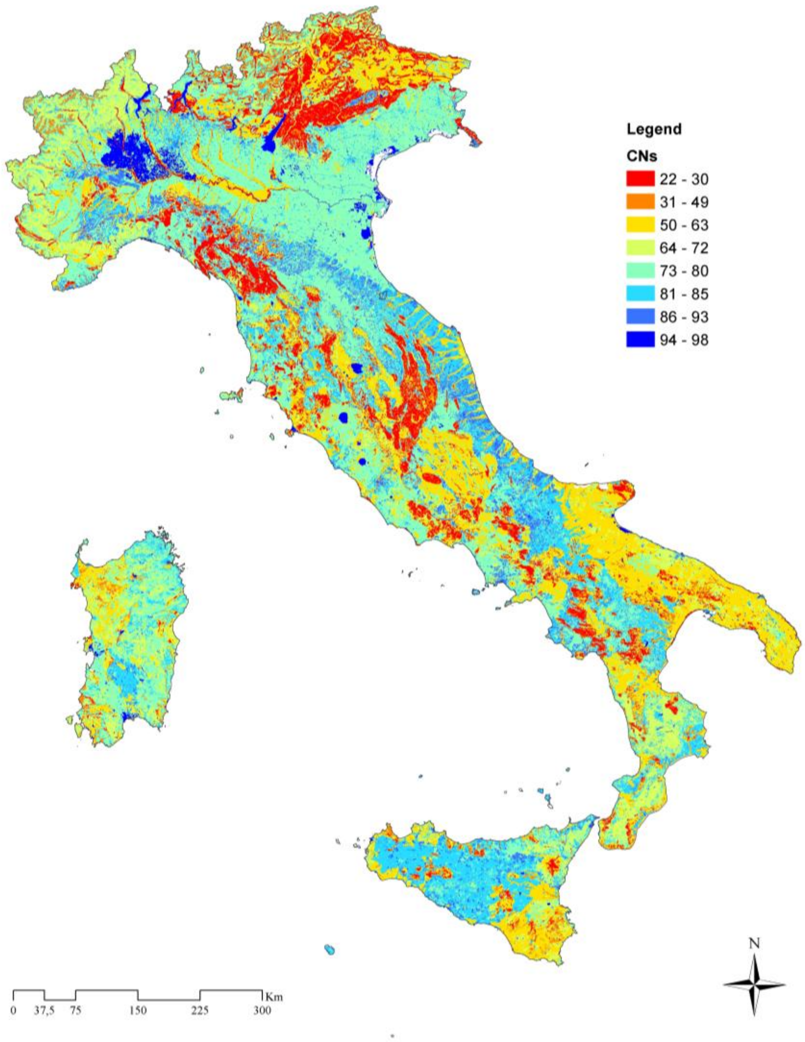



**Figure 6: Curve numbers (for HSG and land use)**

**Table 3: Corine Land Cover classes, code and CN**

| Corine land cover | | Hydrologic soil group | | | |
|---|---|---|---|---|---|
| Classes | Code | *A* | *B* | *C* | *D* |
| Continuous urban fabric | 1.1.1 | 89 | 92 | 94 | 95 |
| Discontinuous urban fabric | 1.1.2 | 77 | 85 | 90 | 92 |
| Industrial or commercial units | 1.2.1 | 81 | 88 | 91 | 93 |
| Road and rail networks and associated land | 1.2.2 | 98 | 98 | 98 | 98 |
| Port areas | 1.2.3 | 81 | 88 | 91 | 93 |
| Airports | 1.2.4 | 72 | 82 | 87 | 89 |
| Mineral extraction sites | 1.3.1 | 72 | 82 | 87 | 89 |
| Dump sites | 1.3.2 | 30 | 58 | 71 | 78 |
| Construction sites | 1.3.3 | 89 | 92 | 94 | 95 |
| Green urban areas | 1.4.1 | 39 | 61 | 74 | 80 |
| Sport and leisure facilities | 1.4.2 | 49 | 69 | 79 | 84 |
| Non-irrigated arable land | 2.1.1 | 63 | 74 | 82 | 85 |
| Permanently irrigated land | 2.1.2 | 63 | 74 | 82 | 85 |
| Rice fields | 2.1.3 | 98 | 98 | 98 | 98 |
| Rice fields | 2.1.3 | 59 | 70 | 78 | 81 |
| Vineyards | 2.2.1 | 62 | 71 | 78 | 81 |
| Fruit tree and berry plantations | 2.2.2 | 62 | 71 | 78 | 81 |
| Olive groves | 2.2.3 | 62 | 71 | 78 | 81 |
| Pastures | 2.3.1 | 30 | 58 | 71 | 78 |
| Annual crops associated with permanent crops | 2.4.1 | 62 | 71 | 78 | 81 |
| Complex cultivation patterns | 2.4.2 | 67 | 78 | 85 | 89 |
| Land princ. occupied by agric., with nat. veget. | 2.4.3 | 67 | 78 | 85 | 89 |
| Agro-forestry areas | 2.4.4 | 45 | 66 | 77 | 83 |
| Broad-leaved forest | 3.1.1 | 25 | 55 | 70 | 77 |
| Coniferous forest | 3.1.2 | 25 | 55 | 70 | 77 |
| Mixed forest | 3.1.3 | 25 | 55 | 70 | 77 |
| Natural grasslands | 3.2.1 | 39 | 61 | 74 | 80 |
| Moors and heathland | 3.2.2 | 25 | 55 | 70 | 77 |
| Transitional woodland-shrub | 3.2.4 | 25 | 55 | 70 | 77 |
| Sclerophyllous vegetation | 3.2.3 | 45 | 66 | 77 | 83 |
| Beaches, dunes, sands | 3.3.1 | 25 | 55 | 70 | 77 |
| Bare rocks | 3.3.2 | 22 | 25 | 35 | 39 |
| Sparsely vegetated areas | 3.3.3 | 61 | 73 | 81 | 84 |
| Burnt areas | 3.3.4 | 61 | 73 | 81 | 84 |
| Glaciers and perpetual snow | 3.3.5 | 36 | 60 | 73 | 79 |
| Inland marshes | 4.1.1 | 98 | 98 | 98 | 98 |
| Peat bogs | 4.1.2 | 98 | 98 | 98 | 98 |
| Salt marshes | 4.2.1 | 98 | 98 | 98 | 98 |
| Salines | 4.2.2 | 98 | 98 | 98 | 98 |
| Intertidal flats | 4.2.3 | 98 | 98 | 98 | 98 |
| Water courses | 5.1.1 | 98 | 98 | 98 | 98 |
| Water bodies | 5.1.2 | 98 | 98 | 98 | 98 |
| Coastal lagoons | 5.2.1 | 98 | 98 | 98 | 98 |
| Estuaries | 5.2.2 | 98 | 98 | 98 | 98 |
| Sea and ocean | 5.2.3 | 98 | 98 | 98 | 98 |

The parameter CN has been estimated, for each river basin, as a weighted mean of all CN present (the weigh is the surface), obtained by the intersection of the CN layer with the river basins shapefile (Figure 7).

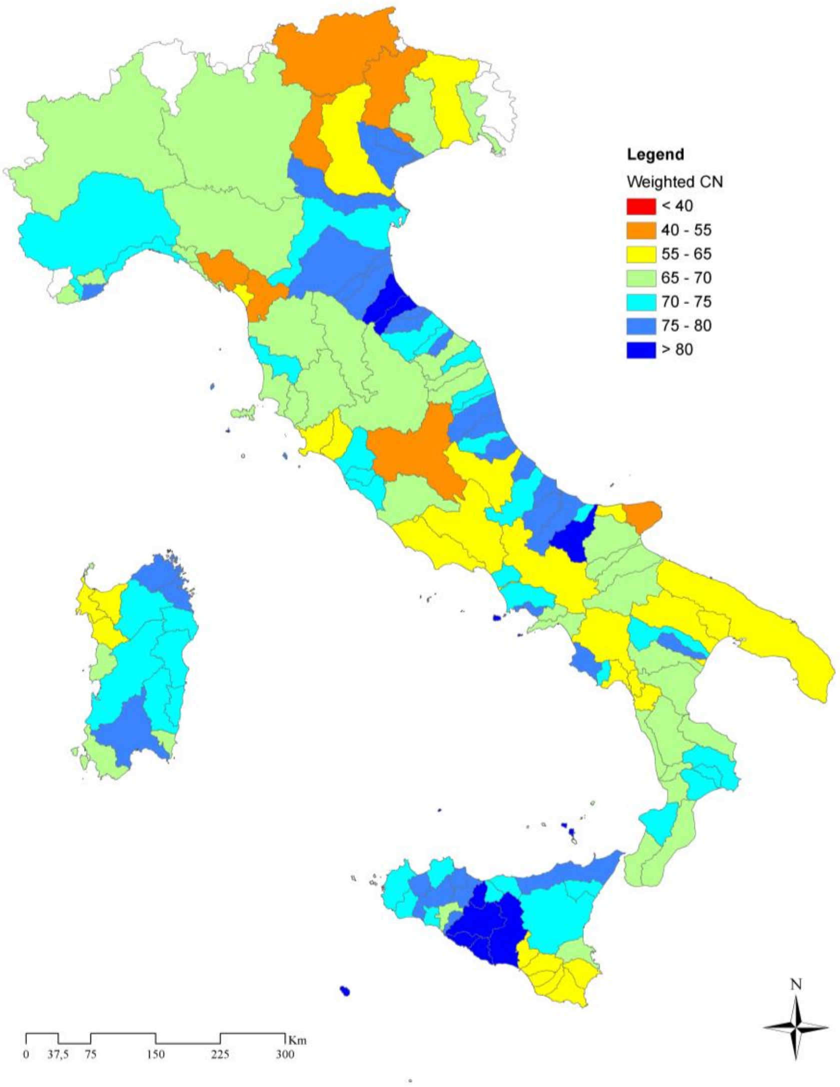
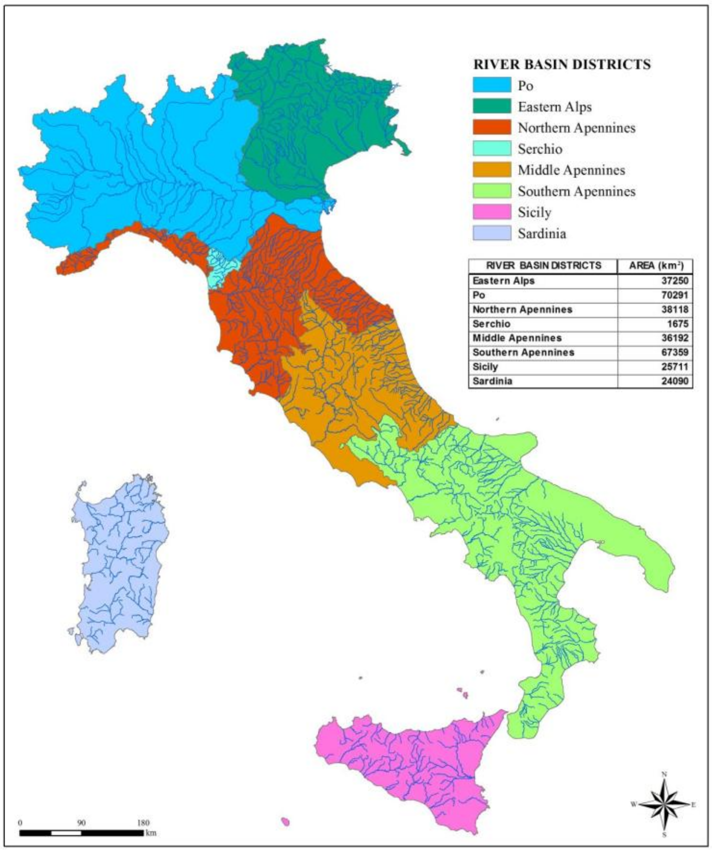



**Figure 7: Weighted CN for river basins**

## The balance at river basin scale

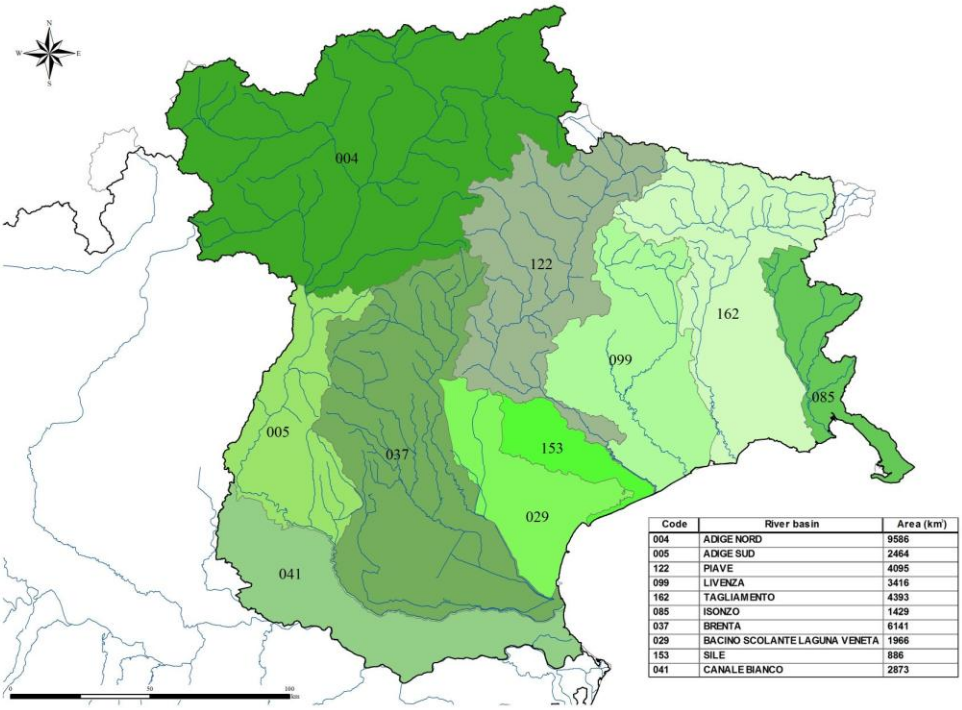
The calculation of the various indicators has been carried out starting from the analysis of the hydrological balance at the scale of river basin in accordance with Directive 2000/60/EC (Water Framework Directive - WFD), which provides that Member States address the protection of water at river basin level and that the territorial unit of reference for the basin management is the river basin district, consisting of one or more neighbouring river basins and of their respective groundwater.

From the aggregation of river basins, according to Art. 64 of Legislative Decree 152/2006, eight river basin districts have been defined: Padano, Eastern Alps, Northern Apennines, Serchio, Middle Apennines, Southern Apennines, Sicily and Sardinia (Figures 8).




| RIVER BASIN DISTRICTS | AREA (km²) |
|---|---|
| Eastern Alps | 37250 |
| Po | 70291 |
| Northern Apennines | 38118 |
| Serchio | 1675 |
| Middle Apennines | 36192 |
| Southern Apennines | 67359 |
| Sicily | 25711 |
| Sardinia | 24090 |

**Figure 8: River basin districts**




| Code | River basin | Area (km²) |
|---|---|---|
| 004 | ADIGE NORD | 9586 |
| 005 | ADIGE SUD | 2464 |
| 122 | PIAVE | 4095 |
| 099 | LIVENZA | 3416 |
| 162 | TAGLIAMENTO | 4393 |
| 085 | ISONZO | 1429 |
| 037 | BRENTA | 6141 |
| 029 | BACINO SCOLANTE LAGUNA VENETA | 1966 |
| 153 | SILE | 886 |
| 041 | CANALE BIANCO | 2873 |

**Figure 8a: Eastern Alps RBD**

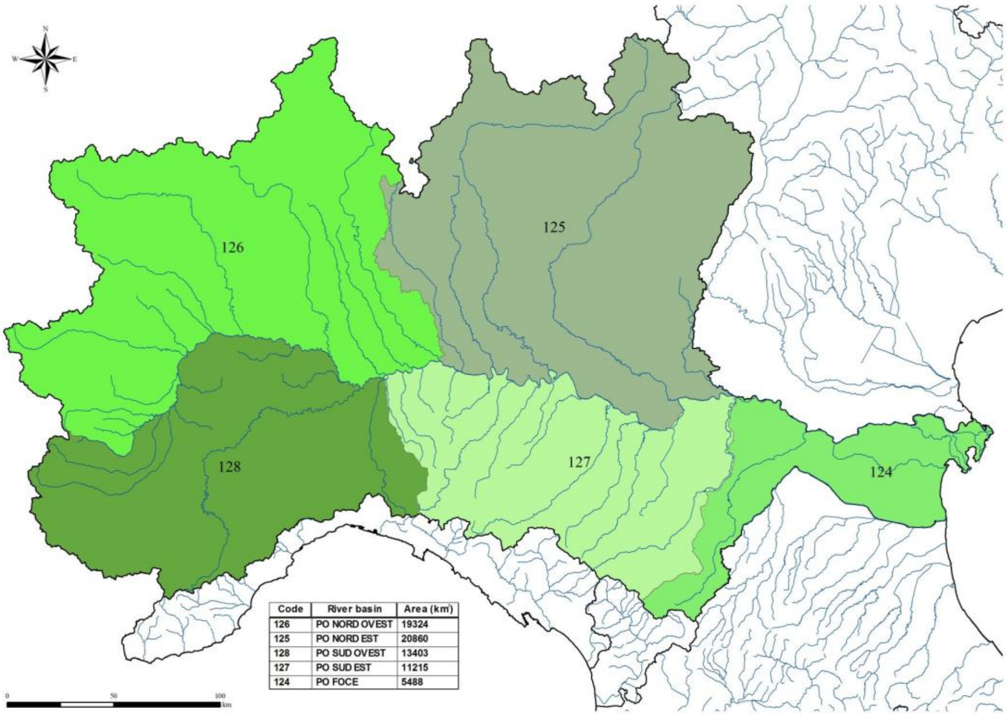



**Figure 8b: Po RBD**

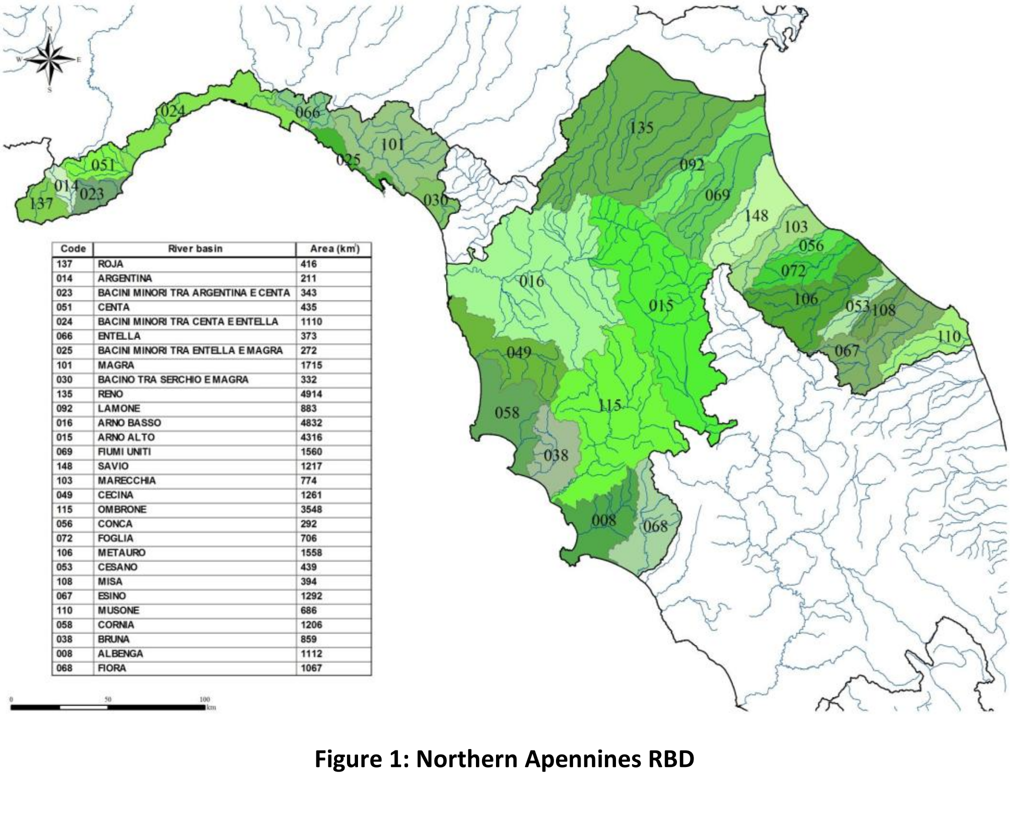
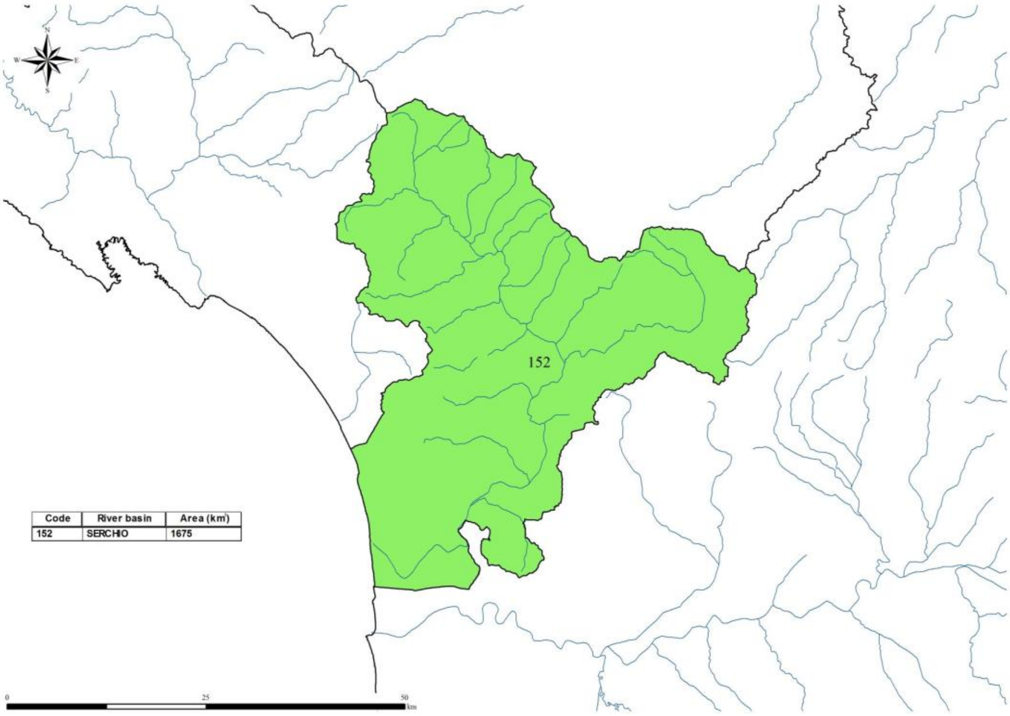
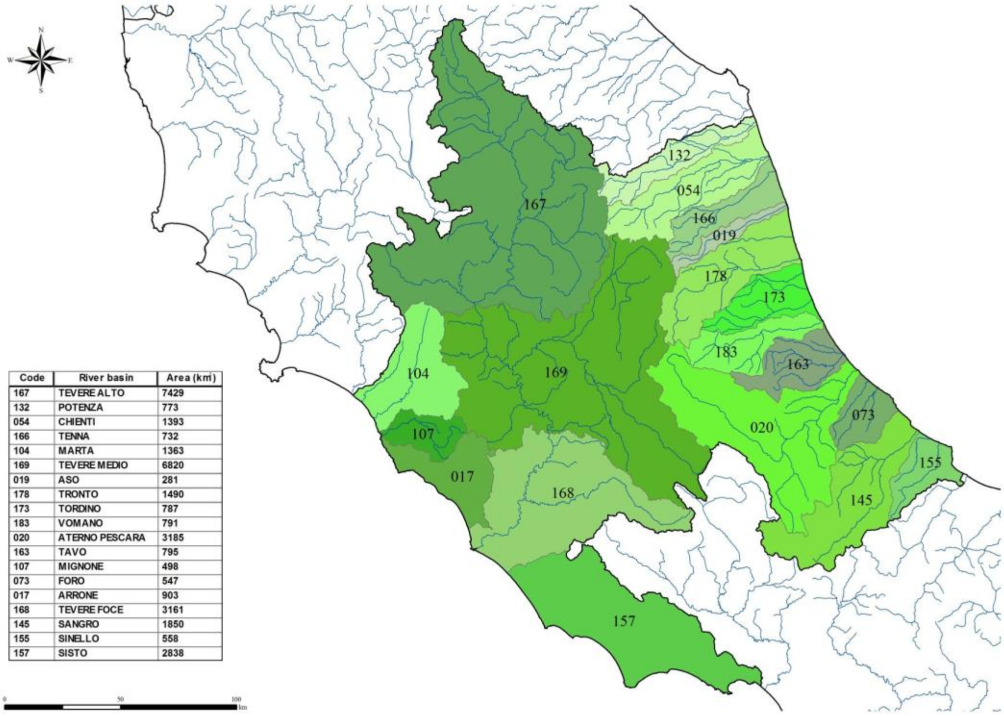



**Figure 1: Northern Apennines RBD**



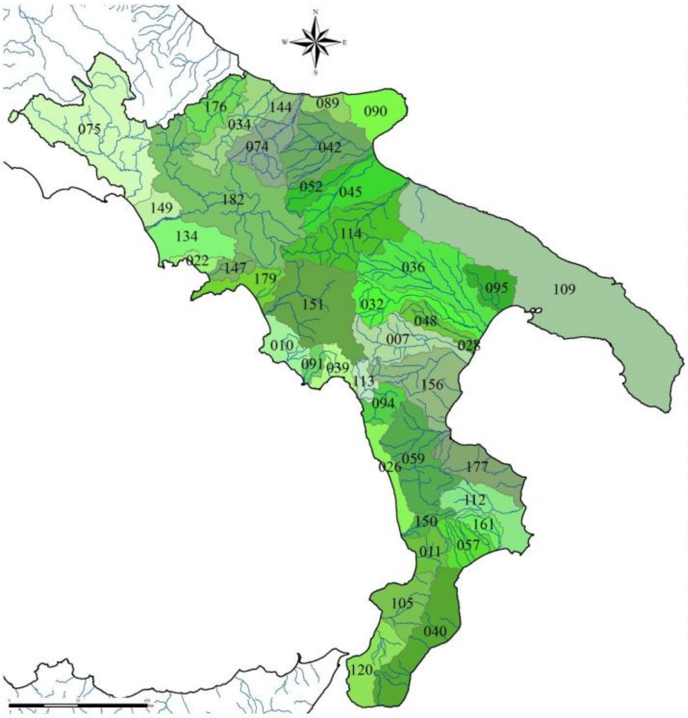

| Code | River basin | Area (km²) |
|---|---|---|
| 152 | SERCHIO | 1675 |

**Figure 2: Serchio RBD**



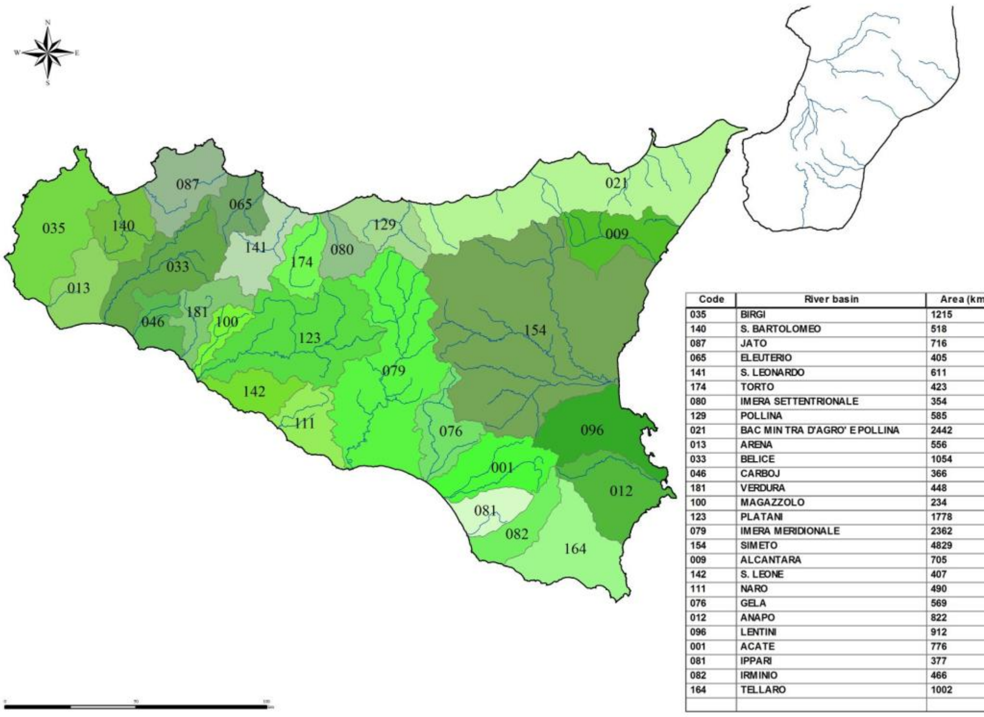

| Code | River basin | Area (km²) |
|---|---|---|
| 167 | TEVERE ALTO | 7429 |
| 132 | POTENZA | 773 |
| 054 | CHIENTI | 1393 |
| 166 | TENNA | 732 |
| 104 | MARTA | 1363 |
| 169 | TEVERE MEDIO | 6820 |
| 019 | ASO | 281 |
| 178 | TRONTO | 1490 |
| 173 | TORDINO | 787 |
| 183 | VOMANO | 791 |
| 020 | ATERNO PESCARA | 3185 |
| 163 | TAVO | 795 |
| 107 | MIGNONE | 498 |
| 073 | FORO | 547 |
| 017 | ARRONE | 903 |
| 168 | TEVERE FOCE | 3161 |
| 145 | SANGRO | 1850 |
| 155 | SINELLO | 558 |
| 157 | SISTO | 2838 |

**Figure 8e: Middle Apennines RBD**



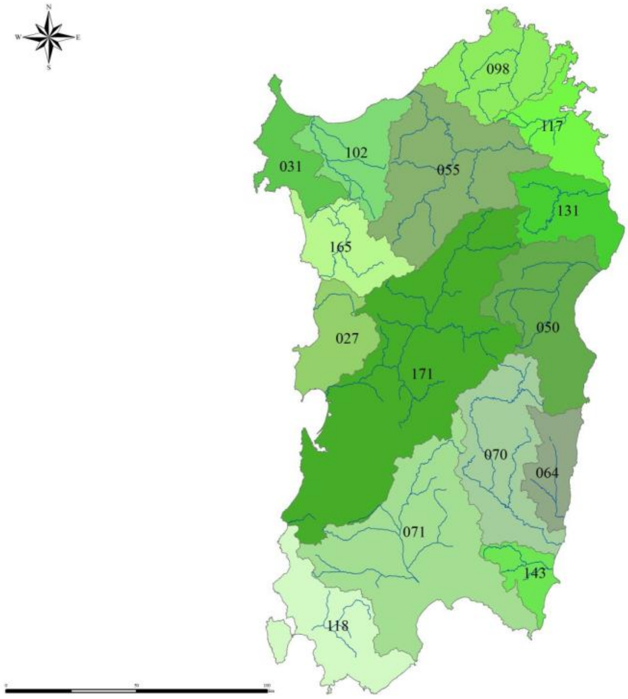
| Code | River basin | Area (km²) |
|---|---|---|
| 075 | GARIGLIANO | 4967 |
| 182 | VOLTURNO | 5623 |
| 176 | TRIGNO | 1212 |
| 034 | BIFERNO | 1597 |
| 144 | SACCIONE | 277 |
| 074 | FORTORE | 1621 |
| 149 | SAVONE | 564 |
| 089 | LAGO DI LESINA | 485 |
| 042 | CANDELARO | 2254 |
| 090 | LAGO VARANO | 1137 |
| 134 | REGI LAGNI | 1365 |
| 052 | CERVARO | 756 |
| 045 | CARAPELLE | 1622 |
| 022 | BACINI MIN TRA SARNO E REGI LAGNI | 280 |
| 147 | SARNO | 432 |
| 114 | OFANTO | 2809 |
| 109 | MURGE E PENISOLA SALENTINA | 9678 |
| 179 | TUSCIANO | 823 |
| 151 | SELE | 3269 |
| 032 | BASENTO | 1536 |
| 036 | BRADANO | 3149 |
| 095 | LENNE E LATO | 885 |
| 010 | ALENTO | 824 |
| 091 | LAMBRO MINGARDO | 307 |
| 039 | BUSSENTO | 570 |
| 113 | NOCE | 375 |
| 007 | AGRI | 1726 |
| 048 | CAVONE | 658 |
| 028 | BACINO MINORE TRA CAVONE E AGRI | 69 |
| 094 | LAO | 665 |
| 026 | BACINI MINORI TRA SAVUTO E LAO | 744 |
| 156 | SINNI | 2216 |
| 059 | CRATI | 2449 |
| 177 | TRIONTO | 1515 |
| 150 | SAVUTO | 412 |
| 112 | NETO | 1551 |
| 011 | AMATO | 716 |
| 057 | CORACE | 912 |
| 161 | TACINA | 427 |
| 105 | MESIMA | 1288 |
| 040 | CALABRIA IONICA | 2327 |
| 120 | PETRACE | 1264 |

**Figure 8f: Southern Apennines RBD**



| Code | River basin | Area (km²) |
|---|---|---|
| 035 | BIRGI | 1215 |
| 140 | S. BARTOLOMEO | 518 |
| 087 | JATO | 716 |
| 065 | ELEUTERIO | 405 |
| 141 | S. LEONARDO | 611 |
| 174 | TORTO | 423 |
| 080 | IMERA SETTENTRIONALE | 354 |
| 129 | POLLINA | 585 |
| 021 | BAC MIN TRA D'AGRO' E POLLINA | 2442 |
| 013 | ARENA | 556 |
| 033 | BELICE | 1054 |
| 046 | CARBOJ | 366 |
| 181 | VERDURA | 448 |
| 100 | MAGAZZOLO | 234 |
| 123 | PLATANI | 1778 |
| 079 | IMERA MERIDIONALE | 2362 |
| 154 | SIMETO | 4829 |
| 009 | ALCANTARA | 705 |
| 142 | S. LEONE | 407 |
| 111 | NARO | 490 |
| 076 | GELA | 569 |
| 012 | ANAPO | 822 |
| 096 | LENTINI | 912 |
| 001 | ACATE | 776 |
| 081 | IPPARI | 377 |
| 082 | IRMINIO | 466 |
| 164 | TELLARO | 1002 |

**Figure 8g3: Sicily RBD**




| Code | River basin | Area (km²) |
|---|---|---|
| 098 | LISCIA | 1305 |
| 031 | BARCA | 752 |
| 102 | MANNU PORTO TORRES | 1013 |
| 055 | COGHINAS | 2500 |
| 117 | PADROGIANO | 907 |
| 165 | TEMO | 953 |
| 171 | TIRSO | 5078 |
| 131 | POSADA | 1010 |
| 027 | BACINI MINORI TRA TEMO E TIRSO | 857 |
| 050 | CEDRINO | 1780 |
| 070 | FLUMENDOSA | 1882 |
| 064 | DURCI | 687 |
| 071 | FLUMINI MANNU | 3423 |
| 118 | PALMAS | 1461 |
| 143 | SA PICOCCA E MINORI | 458 |

**Figure 8h4: Sardinia RBD**

## The balance at regional and river basin district scale

The balances at regional and RBD level have been subsequently derived starting from the calculations at river basin scale. As the regional level limits (NUTS2) are administrative and not geographical (Figure 9), the indicators related to each basin have been correlated to a coefficient given by the ratio between the rate of the surface of each basin in the region under consideration with the regional surface. So doing, the regional figure is the sum of the partial data of all fractions of the basin present in each region.

At RBD scale, the balance is the sum of the indicators of the constituent basins.


**Figure 9: Regions and river basins**

## Indicators

The analysis of the inflow-outflow has been carried on with the aim to calculate the following indicators:

- FR_1 - Precipitation;
- FR_2 - Actual evapotranspiration;
- FR_3 - Internal flow;
- FR_4 - Actual external inflow;
- FR_6 - Total renewable freshwater resources;
- FR_5 - Total actual outflow;
- FR_7 - Recharge into the Aquifer;
- FR_9 - Groundwater available for annual abstraction.

Values of the balance parameters and of the Eurostat indicators are expressed in millions of $m^3$/year.

## Precipitation – FR_1

This indicator has been obtained by the intersection of the river basins map (ESRI shape) with the monthly pluviometric layers, thus deriving 12 layers related to the 1971-2000 (LTAA) and monthly time series 2001-2010, necessary to implement the model. The annual precipitations of each river basin have been calculated as sums of the monthly values.

## Actual evapotranspiration – FR_2

The Actual evapotranspiration (E) has been derived indirectly from the monthly water-balance model based on the methodology originally presented by Thornthwaite (Thornthwaite, 1948; Mather, 1978; 1979). Inputs to the model have been: monthly precipitation, potential evapotranspiration and soil-moisture storage capacity. The sum of the 12 months computes the total yearly actual evapotranspiration, in millimeters, for each river basin.

## Potential Evapotraspiration (Et0)

The Et0 has been estimated by the Hargreaves-Samani (HS) method using gridded variables of monthly minimum and maximum temperatures.

The HS method has been calibrated by the FAO-Penman–Monteith (PM) equation (FAO, 1998) using daily data records relative to 49 weather stations of the RAN network, homogeneously distributed over the country. For this purpose, the daily data for the time period 1992-2012 have been: maximum temperature (Tx), minimum temperature (Tn), maximum relative humidity (RHmax), minimum relative humidity (RHmin), average relative humidity (RHmean), wind speed at a height of 2 m (U) and net solar radiation (Rs). The data passed a careful quality control according to WMO guidelines (WMO, 1993; 2008; 2010; 2011). Daily Et0, estimated by the PM and HS models, have been compared using simple error analysis and the linear regression method. The two methods have been compared before and after adjustments. For each station and for each month, the root mean square error (RMSE) has been also calculated. 12 monthly values of the *C* coefficients, for each station, have been chosen according to the lowest RMSE index, and then spatialized over the country with IDW (Inverse Distance Weighting) methods, on a regular grid of 0,1° to the side (3193 knots).

So, a gridded Et0 database has been built: it is represented by 12 layers of information related to the 1971-2000 (LTAA), and 120 total layers of information for the years 2001-2010. The spatial overlay of this maps of Et0 with polygons of the river basins (ESRI shapefile), has provided monthly potential evapotranspiration for each basin.

## Soil-moisture storage capacity (RI)

The soil-moisture storage capacity (RI) for each river basin, or portion thereof, has been assumed equal to the Available Water Capacity (AWC) of soils present (Figure 10). For this variable, reference has been made to the soil data of the Experimental Institute for Soil Study (ISSDS) where the AWC parameter used has been derived from 30-arcsec grid resolution (approximately 1000 meters at 42°N latitude). Geoprocessing tool in ArcInfo$^{TM}$ has been used to write for each polygon of river basin layer, a statistical summary of the AWC cells-grid that fall within these bounds.

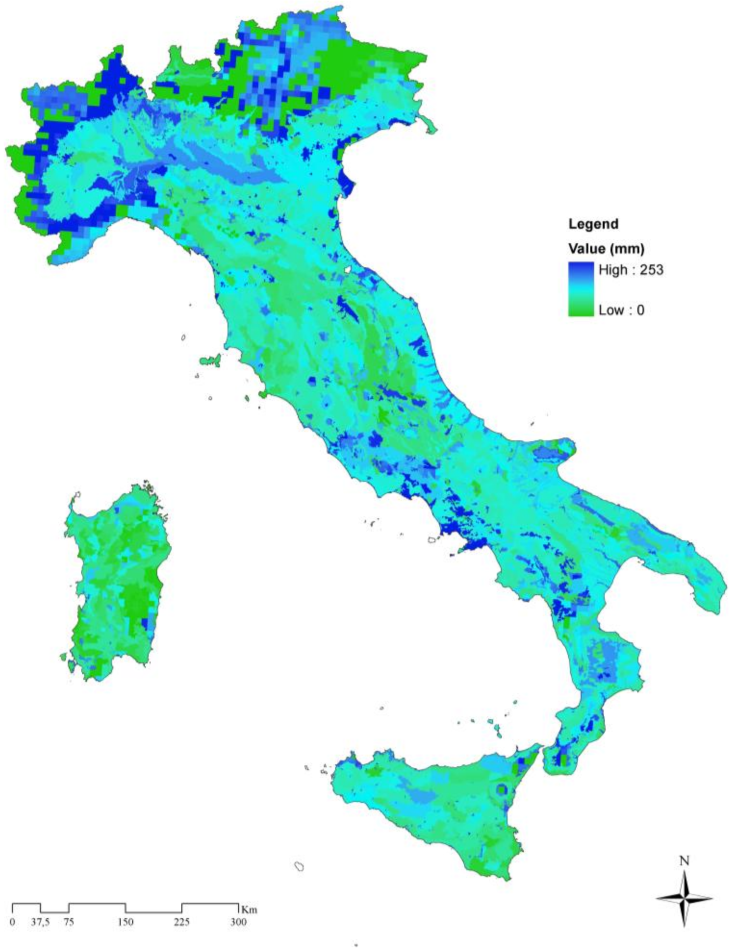



**Figure 10: Soil water capacity**

## Internal flow – FR_3

The comparison between the flow of water in and out of a system is the water balance that allows a quantitative estimate of the movements of water.

Starting from the equation of water balance

$$P=R+Ie+E$$

where:

P= Precipitation;

R= Runoff;

Ie= Recharge into the aquifer;

E= Actual evapotranspiration

P-E= Effective rainfall

it is obtained P-E= R+I, that is the internal flow. On the strength of this formula, in the case of lack of hydrometric gauging stations the indicator has been indirectly estimated using precipitation and actual evapotranspiration.

## Actual external inflow – FR_4

The actual external inflow represents the inflow coming from National or International basins.

The flow measured by the stations located at the end of the basin is the sum of surface and underground contributions, so it is not representative of the river basin, but it is function of the hydrogeological structure. As consequence, the effective precipitation and the river flow are not always equal; the difference has been distributed between neighbouring basins (tab. 3).

A positive difference between the effective rainfall and streamflow means that a rate of rainfall of the basin contributes to the flow of neighbouring ones; instead, when the difference is negative it means that the basin receives water. The total runoff entering the district are the result of the redistribution of the surplus of effective rainfall compared to the streamflow of the neighbouring basins. When two neighbouring basins have the above-mentioned difference of the same sign, they have not interactions and so they do not contribute to the respective flow rates.

All the input rivers in Italy and their discharge have been identified. Data not available have been reconstructed with the runoff coefficient method (inflows/outflows), starting from values retrieved in literature.

For the basins of Po and Adige rivers, as their aquifers are extended beyond the national boundaries, it is not correct to compare the rainfall, which are only referred to a national value, with flows of the hydrogeological basin, which have, clearly, not only a national component.

In detail, for the Po River basin the actual external inflow from neighbouring territories has been derived as difference between the effective precipitation on its basin (IF) and the flow rate measured at the station Pontelagoscuro, taking the national flow equal to the internal flow (IF). In this way, therefore, all that is greater than the effective rainfall is considered external outflow (EI).

For the Adige river basin, instead, the actual external inflow has been calculated as a portion of the total flow measured at the gauging station at the mouth, Boara Pisani; the proportion utilised is the ratio between the international part of the perimeter to the total one of the river basin.

## Total renewable freshwater resources – FR_6

The total renewable water resources are the sum of effective rainfall and actual external inflow, that is what should be measured in the river basin in case of no losses to the outside.

## Total actual outflow – FR_5

The total actual outflows exiting from the river basins are the discharges of rivers that flow into the sea. 158 hydrometric stations have been used to calculate this indicator, but only some of these stations provided complete data for the monitored basins.

The total outflow out of the district is the result of the redistribution of the surplus (or of the deficit) between discharge and effective rainfall of the basins (Table 4).

**Table 1: Middle Apennines RBD balance (year 2002)**

| River basins | P | E | IF | O | R | Ie | Method applied |
|---|---|---|---|---|---|---|---|
| *Tevere* | *15,494* | *11,140* | *4,355* | *4,125* | *710* | *3,415* | *measured* |
| *Aterno Pescara* | *2,823* | *2,006* | *817* | *1,314* | *271* | *1,043* | *measured* |
| Arrone | 769 | 607 | 162 | 166 | 69 | 97 | estimated |
| Marta | 1,209 | 949 | 260 | 268 | 84 | 184 | estimated |
| Mignone | 449 | 354 | 95 | 98 | 33 | 66 | estimated |
| Potenza | 664 | 496 | 168 | 174 | 42 | 131 | estimated |
| Sisto | 2,477 | 1,798 | 679 | 702 | 145 | 557 | estimated |
| Aso | 239 | 174 | 64 | 66 | 24 | 42 | estimated |
| Chienti | 1,205 | 896 | 309 | 319 | 82 | 237 | estimated |
| Tenna | 627 | 469 | 158 | 162 | 68 | 94 | estimated |
| Tronto | 1,234 | 868 | 366 | 311 | 152 | 158 | estimated |
| Sangro | 1,581 | 1,206 | 375 | 301 | 119 | 182 | estimated |
| Foro | 523 | 379 | 143 | 131 | 102 | 29 | estimated |
| Tavo | 737 | 530 | 207 | 183 | 124 | 59 | estimated |
| Vomano | 690 | 500 | 190 | 158 | 80 | 78 | estimated |
| Tordino | 651 | 484 | 166 | 166 | 102 | 64 | estimated |
| Sinello | 434 | 379 | 55 | 55 | 37 | 18 | estimated |
| **Middle Apennines RBD** | **31,805** | **23,235** | **8,570** | **8,699** | **2,244** | **6,455** | |

(P) precipitation (ET) actual evapotranspiration (IF) = internal flow (R) runoff (Ie) recharge into the aquifer

## Recharge into the Aquifer – FR_7

The recharge into the aquifer has been calculated using data coming from hydrometric stations located at river mouth, when available.

The analysis of monthly flows has allowed to decompose, the hydrograph in two components, 'run-off' and 'base flow'. The base flow has been assumed to be equal to the flow rate of the month with the lowest average; the runoff is the difference between the average annual flow (or an average of the thirty years, LTAA) and the base flow (Boni et al., 1993).

The base flow represents the recharge into the aquifer (Ie).

For the river basins without hydrometric gauging stations, the recharge into the aquifer has been estimated using the water balance. The effective infiltration, representing the underground component of the measured outflows, is affected by the underground trade between the basins. So the surplus / deficit, derived from the difference between the flow rates and the effective rainfall, contribute to the variation of the effective infiltration, equal to the recharge into the aquifer.

## Groundwater available for annual abstraction – FR_9

This indicator, according to the Eurostat definition, is calculated as the "*Recharge less the long term annual average rate of flow required to achieve ecological quality objectives for associated surface water"*.

As in Italy there is no a national legislation that takes into account of the ecological restrictions of the groundwater exploitability and given the scale at which the data refer to the calculation, it has been adopted the 80% criterion of "Recharge into the Aquifer".

# CHAPTER TWO - PUBLIC WATER SUPPLY

## Introduction

In this chapter methodological aspects at the base of calculation of some of the indicators related to public water supply, filled in REQ e Inland water questionnaires, are described.

In particular, indicators produced at the end of this grant project are:

for the REQ data collection "Inland Water":

- Table 1.2.R - Total gross water abstraction and water losses by source - by RBD
  - Fresh surface water – of which Public water supply
  - Fresh groundwater – of which Public water supply
- Table 1.2.N - Total gross water abstraction and water losses by source - by NUTS2
  - Fresh surface water – of which Public water supply
  - Fresh groundwater – of which Public water supply

for the JQ - IW:

- Table 2: Annual freshwater abstraction by source and by sector
  - Fresh surface water – of which Public water supply
  - Fresh groundwater – of which Public water supply
  - Total surface and groundwater – of which Public water supply
- Table 3: Water made available for use
  - Desalinated water – of which Public water supply
- Table 4a: Water use by supply category and by sector
  - Public water supply – Total

## Data source

The main data source on water supply is the Istat “Urban Water Census” that is the unique survey that investigates the public water supply in Italy.

Since 1951 Istat periodically has collected information on water resources for domestic use through a specific census with the aim of describing the state of urban water services in Italy. The survey chronology (1951, 1963, 1975, 1987, 1993, 1999, 2005, 2008, 2012) has allowed to develop an information basis that is progressively up-to-date by considering both the European directives on water and the increasing require of information from public institutions and private stakeholders. After the edition of 1999, both the contents and the production process have been deeply renewed.

The last edition of water services survey refers to 2012. In this moment checking and validating data is going through with the aim to obtain the maximum coverage and a better data quality.

The respondents are the water management companies. In the edition 2008 there were 3351 companies, of which 2800 municipalities.

The fields of investigation are: (i) water abstraction and transmission, (ii) public supply network, (iii) public sewerage and (iv) wastewater treatment plants.

## Water abstraction for drinkable use

Urban water census observes the sampling points of water abstraction.

For each point of abstraction variables requested are:

- geographical coordinates
- municipality
- volume of water abstracted
- volume of water treated for drinkable use
- source (spring, well, water course, natural lake, artificial basin, marine and brackish water)

The check and the validation of the geographical coordinates, in the 2008 edition, allowed to calculate volumes of abstracted water by source, not only for administrative domains (like municipality and NUTS2), but also for RBD level.

## Public water supply

For each municipality managed (in Italy there are about 8100 municipalities) the water management company has to fill in the questionnaire the following variables:

- Water input to a municipal distribution system
- Water supplied
- Water invoiced for the different uses

In particular, the ratio between water supplied and water input to a municipal system represents one of the indicators requested by the Ministry of Economic Development which provides incentives, based on the achievement of the target or on the enhancement of the performance, for national southern regions.

As said before, indicators required in the questionnaire (Total public water supply) have been calculated at regional level (as aggregation of municipalities) and at RBD level. These data will be updated after the validation of the Urban Water Census 2012.

# CHAPTER THREE - URBAN WASTEWATER

## Introduction

In this chapter a synthetic analysis is shown to describe data about urban wastewater and the main methodological choices to fill in the following tables:

For the REQ data collection "Inland Water" questionnaire:

- Table 1.5.N - Treatment capacity of wastewater treatment plants - by NUTS2
    - Urban and Other Wastewater Treatment

      Primary treatment
      Plants
      Incoming load $BOD_5$

      Secondary treatment
      Plants
      Incoming load $BOD_5$

      Tertiary treatment
      Plants
      Incoming load $BOD_5$

- Table 1.6.N - Generation and discharge of wastewater - by NUTS2

  BOD - Wastewater Treatment and Discharge
  Wastewater treated in WWTP (inflow, urban or other)

For the JQ - IW:

- Table 6 - Treatment capacity of wastewater treatment plants, in terms of $BOD_5$
    - Urban Wastewater Treatment

      Total treatment
      Plants
      Incoming load $BOD_5$

      1. Primary treatment
      Plants
      Incoming load $BOD_5$

      2. Secondary treatment
      Plants
      Incoming load $BOD_5$

      3. Tertiary treatment: Total
      Plants
      Incoming load $BOD_5$

## About indicators

Data utilised for the indicators calculation derive from Istat Urban Water Census, described in the previous chapter.

According the Council Directive 91/271/EEC, concerning urban wastewater treatment, "1 p.e. (population equivalent)" means the organic biodegradable load having a five-day biochemical oxygen demand ($BOD_5$) of 60g of oxygen per day; the incoming load $BOD_5$ has been calculated by multiplying this value, agreed as the average BOD load for one person in one day, by the number of population equivalent (using the urban collecting system), correspondingly to each treatment type.

It is important to highlight that also the data provided in the tables 1.5.N and 1.6.N only refer to all treatment of wastewater coming, from Urban Wastewater Collecting System, in Urban Wastewater Treatment Plants (UWWTP). Other wastewater treatment, i.e. wastewater treatment in industrial wastewater treatment plants (IWWP), is excluded in the calculation described beforehand.

# CONCLUSIONS

Thanks to this grant project Istat obtained important outcomes.

First of all, it is the first time, in Italy, in the production of indicators related to Water resources required by Eurostat/OECD, with a high spatial detail.

As it was necessary to integrate data coming from administrative sources and from statistical survey, with several and different standard and methodologies, a research group has been constituted to overcome the information gap due to the lack of a national information system on water resources. So, as in Italy there is not an authority that supplies all the information requested in the questionnaires, all steps (from data collection to the estimation models) have been performed, for the first time, by the Istat's research team. The start-up has been difficult and complicated, creating a delay in the conclusion of this project and in the dissemination of results.

It has been clearly necessary to develop methods for calculating the indicators; in particular for some of them ad hoc studies and in-depth analysis have been carried out to best define the methodology and to perform data collection and validation.

Another important outcome has been the creation of a closer communication whit data producers (water management companies, national meteorological and hydrological services) and a closer collaboration with the scientific community.

The Italian experience showed that stakeholders and data producers participation grows making reference to Eurostat requests. Eurostat grant project can be considered an important instrument for improving water statistics.

Analysing the budget committed for this activity, it has been greater than the one provided by Eurostat Grant. Furthermore, given bureaucratic organizational problems, due mostly to the high complexity of Italian recruiting procedures, it has been not possible to use all the allocated budget.

Of course, Istat's activity on Water statistics field is not finished with this Grant. The production of the indicators required by Eurostat/OECD will continue and will be refined. The results will be sent to Eurostat through the official channels and will be also disseminated on the Istat's data warehouse with the aim to answer to a more and more growing international and national data enquiry on Water issues.

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