Water data sharing in Italy with SIGRIAN WebGIS platform

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Abstract. SIGRIAN (National Information System for Agriculture Water Management) is a web GIS platform developed and managed by the Council for Agricultural Research and Economics, Centre for Politics and Bio economics (CREA-PB). This GEOdatabase is operating since 1998 and recently it has been established by the Italian Ministry of Agriculture (MIPAAF) as the reference repository for the irrigation data collection at national scale. SIGRIAN collects both geographical information concerning the hydraulic network schemes of the national water boards (Consortia and Water Associations) and information technically and economically related to the management of water resources in agriculture. SIGRIAN will be used as database for economic evaluations to address policy related to water resources in agriculture and to support the assessment of optimal water resource allocation.

Keywords: Irrigation, Water policy, Water Framework Directive (WFD), Rural Development Program (RDP), Web GIS, Geodatabase

1 Introduction

"We commit to approaches that improve sustainability of water use in food and agricultural production while ensuring food security and nutrition in accordance with our multilateral trade commitments". This obligation is taken from G20Agriculture Ministers' Action Plan 2017 entitled *Towards food and water security: fostering sustainability, advancing innovation* [2] and it shows the pressure on water Governance and water-related policies ensuring the sustainable use and management of water. The total irrigable area in EU-28 is circa 18.7 million ha, with 10.2 million ha actually irrigated and the amount of water used for irrigation estimated around 40 billion cubic meters. The highest volume of water used for irrigation in absolute terms was in Spain, where 16.7 billion m³ is used, followed by Italy with 11.6 billion m³ (Eurostat[1]). In these two Mediterranean countries the economic sustainability of

[1] Eurostat 2016 http://ec.europa.eu/eurostat/statistics-explained/index.php/Agri-environmental_indicator_-_irrigation

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farms is strongly dependent on irrigation, due to the scarce rainfalls and its uneven distribution across the year [2]. Water is critical for economy, food security, environment, and well-being of citizens. At the same time, water scarcity, pollution of fresh water sources, and the effects of more frequent and intense floods and droughts can have severe societal and economic impacts. To prevent these risks, investment and innovative solutions are essential. In this context IT solutions play a crucial role in providing support for the optimal water allocation and water saving; they can also drive the water policies providing the rulers with the impact assessment. The assessment of policy options provides the water authorities with socio-economic and environmental analysis impacts for all options.

The 2000 Water Framework Directive (WFD) [3] and other water-related directives have contributed to improving water protection in the EU. WFD is widely accepted as the most substantial and ambitious piece of European environmental legislation to date. The purpose of the Directive was to establish a framework for the protection of European waters in order for Member States to reach "good status" objectives for water bodies throughout the EU. Pollution from urban, industrial and agricultural sources is subject to regulation. The implementation of WFD relies on Member States taking a range of cost-effective measures (PoMs) in a transparent and participatory way: the identification of management action (the distance between current and desired water body state) and the process used to monitor the effectiveness of PoMs (measures applied to reduce this distance) require a large amount of information.

Concerning the European Agricultural Fund for Rural Development (EAFRD) some ex-ante conditionalities (EACs) are set out in the Fund specific rules and reflect existing commitments or obligations that should be fulfilled as a general rule by programme adoption. In case applicable ex-ante conditionalities are not fulfilled (either completely or partially not-fulfilled), Member States need to indicate in their Programmes and Partnership Agreement the actions to be taken, the responsible bodies and a timetable to ensure their fulfillment. If the Commission concludes that the applicable EACs have not been fulfilled, then EACs dependent payments may be suspended. Compliance with EAC 5.2, on water pricing and cost recovery in the agriculture sector (implementation of WFD article 9) applies to investments in irrigation under Priority area 5 A (water efficiency).

In the context outlined above a robust monitoring infrastructure is crucial to manage the requirements and commitments set up by the EU water policies. SIGRIAN is at the heart of this data network.

The effective management of water is becoming more and more important as the world supply of clean, fresh water is steadily decreasing. United Nations [4] and European Commission [5] recognize ICT as an important enabler to improve the management of the valuable natural resource.

2 SIGRIAN information content

SIGRIAN (Fig. 1) is the reference database for the irrigation sector identified by the Italian Ministry of Agriculture. It is a Geographic Information System managed by

the Council for Agricultural Research and Economics, Research Centre for Agricultural Policies and Bioeconomy (CREA-PB) and realized in collaboration with the National Water Boards and the Regions. It contains geographic and alphanumeric spatial data concerning irrigation features in collective irrigation areas (Irrigation and Land Reclamation Consortia, Consortia for land improvement, Irrigation associations etc.), such as:

- Administrative boundaries
- Irrigated and irrigable areas
- Irrigation supply
- Irrigation networks
- Hydrographic network
- Crop type
- Climatic characteristics

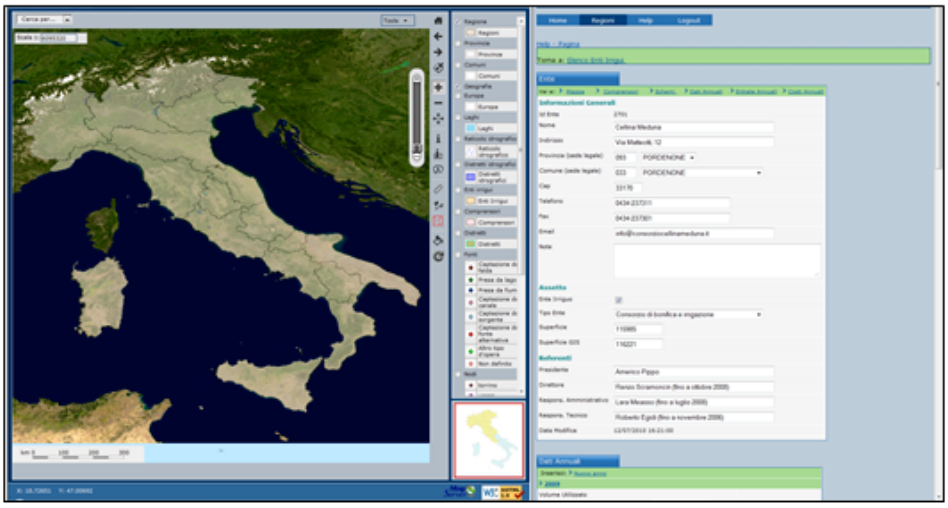

Fig. 1. SIGRIAN WebGIS home page

SIGRIAN is a repository and a catalogue, which ensures integrity of data and information acquired and produced by the Italian irrigation sector. It allows the data exchange and sharing with appropriate users, including download of data reports and information for different user groups. It provides facts and figures about the Irrigation infrastructure compiled from a variety of authoritative sources, it provides information, diagrams and other pertinent information on hydraulic networks, irrigation schemes, reservoirs and gauges.

Environmental Information Systems (EIS), are understood as an organized set of resources (staff, data, procedures, hardware, software,...) for collecting, storing, processing data and for delivering information, knowledge, and digital products. In the context of water resources management, these information systems are sometimes also called hydrological information systems (HIS) [6, 7, 8]. Within this category

SIGRIAN is a water information system (WIS), which integrates many sources of information related with irrigation water resources:

- Irrigation projects funded by the National Irrigation Infrastructure Plan
- Meteorological data from the National Agrometeorological Network (RAN)
- Data on natural disasters and related damage of municipal and provincial details coming from official acts of the Italian Ministry of Agriculture (MIPAAF)
- Crops and related irrigation volumes calculated with hydrological models such as Irriframe developed by ANBI [9]
- Estimated irrigation needs in areas covered by the FATIMA-SIRIUS[2] model based on satellite information [10]
- Irrigation volume withdrawn, used and returned both for collective irrigation and for self-provided irrigation (i.e wells)
- Agronomic information from CAP payments applications (crops, fields size, irrigation etc..)

Many WIS are available in European countries and all over the world. The Water Information System for Europe called WISE[3] collects information on European water issues and it comprises a wide range of data and information gathered by EU institutions to serve several stakeholders. The WISE-WFD database contains data from River Basin Management Plans reported by EU Members States according to article 13 of the Water Framework Directive. WISE also provides guidelines and datasets for the water quantity and quality reporting from countries as part of implementation of EU directives. SIGRIAN is compliant with the EU WISE datasets.

AQUASTAT is FAO's global water information system, developed by the Land and Water Division[4]. It is the most quoted source on global water statistics. It collects, analyze and disseminate data and information by country on water resources, water uses, and agricultural water management.

The California Irrigation Management Information System (CIMIS)[5], developed in 1982 by DWR and the University of California, manages a network of over 145 automated weather stations in California and was designed to assist irrigators in managing their water resources more efficiently.

Orange–Senqu water information System (wiS)[6] [11] promotes the equitable and sustainable development of the resources of the Orange-Senqu River (Botswana, Lesotho, Namibia and South Africa) and supports data and information sharing between the ORASECOM riparian States.

In comparison with other platforms SIGRIAN has its strong point in managing both strategic information about the irrigation networks (like WISE or ACQUASTAT) and operational seasonal data concerning water volumes, flows and water usage (like wiS or CIMIS).

[2] FATIMA project: http://fatima-h2020.eu/
[3] WISE: https://www.eea.europa.eu/data-and-maps/data/wise_wfd
[4] ACQUASTAT FAO: http://www.fao.org/nr/water/aquastat/main/index.stm
[5] CMIS: http://www.cimis.water.ca.gov/
[6] wiS: http://wis.orasecom.org/

3 Users and platform usage

SIGRIAN is fully web-based and the different stakeholders are able to edit and update the information operating online. It has been developed using open source software: PHP as programming language, PostgreSQL as GeoDB and Map Server as cartographic engine and it is hosted on a Windows server.

SIGRIAN is not a platform open to the public because most of the information has a strategic significance and includes financial aspects. The registered users are about 350 which are part of the decision makers and planners of the national irrigation sector:

- Ministry of agriculture MIPAAF
- Ministry of environment MATTM
- Ministry of Infrastructures and Transport MIT
- Regional administration
- Water management boards: Consortia and Irrigation associations
- River basin authorities

In the user group both the final users of the water resource like the water management boards of the agricultural sector and the authorities in charge of ruling and planning the resource allocation at regional and basin level together with the policies makers (Ministries) are represented. Data elaborations are provided on demand to other public bodies, universities and research centers.

In 2016 the number of logins per month was around 300 and the number of data report requests was ten per month. The DB size is currently around 700 Mb.

4 Details on the information content

SIGRIAN contains data concerning irrigation features in collective irrigation areas that are gathered by Water Management Boards (Consortia and Irrigation associations), with the support of National Association for Land Reclamation and Irrigation (ANBI), and Regions. Anyhow data integrated in SIGRIAN are validated by Regions and are available for all Italian institutions with administrative competence on water management.

Data collected are about administrative boundaries, personnel and concerned areas, irrigation supply, irrigation network characteristics, hydrographic network, crops. Data on private irrigation volumes at municipal and water body basis scale will be available by 2018. The ever-changing system allows the integration of other information useful for administrative and technical water management and for analysis, such as: financial and structural data on projects funded at National and Regional level, types of crops and irrigation water volumes used on collective irrigation areas (measured or estimated) by decision support models for irrigation water management applied by Consortia (mainly Irriframe-ANBI platform), irrigation water abstraction volumes (measured or estimated) and quantitative and qualitative status of water bodies (Ministry of the Environment).

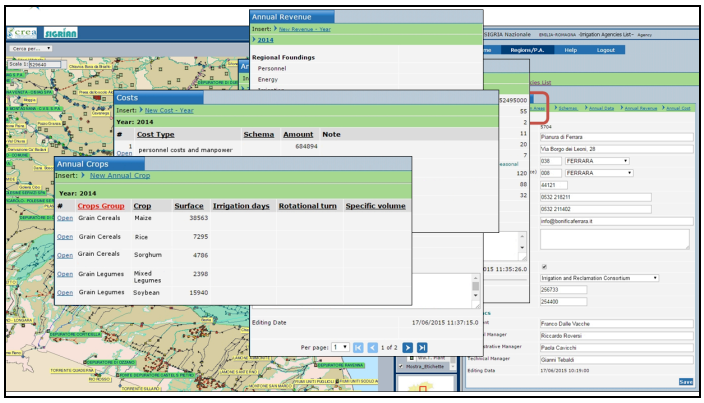

Fig. 2. Sample of financial information on collective irrigation in SIGRIAN

Through this GEOdatabase, all stakeholders can easily access to a large amount of information, both technically and economically related to the water resource management in agriculture (Fig. 2 and Fig. 3). It will be used as a DSS (Decision Support System) platform for economic evaluations to address policy related to water resources in agriculture.

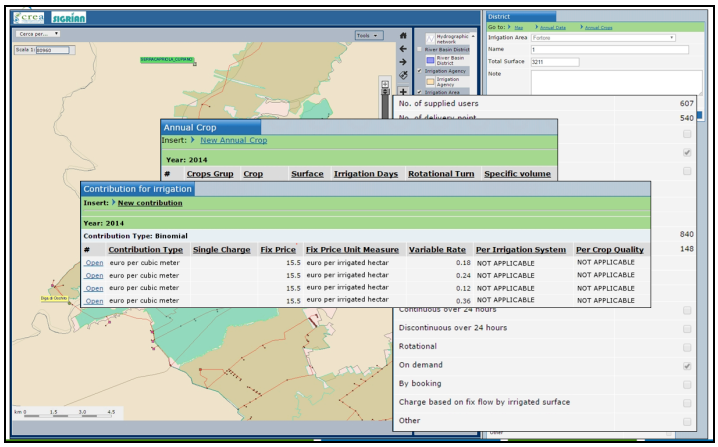

Fig. 3. Sample of district crops and related information on irrigation fees

SIGRIAN is useful to assess the optimal allocation of water resources and is providing also support to the National Observatories of Water Uses (OWU). During 2016 the Italian Government identified measures to prevent and monitor the negative consequences of drought. According to Water Framework Directive (WFD), the OWUs were established. The OWUs were included among the measures provided in the River Basin Management Plans for each Italian River Basin District. Members of the OWU are the public water authorities.

SIGRIAN is also a key tool for data sharing to lead water-saving actions and economic evaluation of externalities (negative or positive) related to drainage and irrigation.

5 Conclusions

ICT tools can be used innovatively by water authorities to obtain information in real time about water use, to track and forecast the water resource availability and to drive the water polices. The information availability about current situation on a near real time basis is crucial for decision making in water resource management mainly under crisis conditions.

In 2015 to answer to ex-ante conditionality on water resources, the Italian Ministry of Agriculture published the Guidelines for Irrigation Volumes Quantification and Monitoring related to water pricing (Ministry decree July 31, 2015) that designate SIGRIAN as the reference GEOdatabase to collect the irrigation volumes data originated from both private and public water users. Also for this reason in the next years SIGRIAN will become a large repository of seasonal data on water usage in agriculture. The adoption of smart metering technologies for the main points of the irrigation network will provide SIGRIAN users with information in near real-time about water use, thus monitoring water wastefulness and having better control over the national water demand for irrigation.

Concerning the future development of the platform a new adaptive user interface will be released in the next year together with a group of REST calls for the system integration.

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