

Building of national database on water volume consumption for rice cultivation

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Abstract: *This paper reports the preliminary results obtained through a survey on the average volume of water per hectare used for growing rice on national scale. The study aims at building of a national database at municipality scale, of the average water volume used for the growing cycle of the crop. The methodology is based on the collection, harmonization and extrapolation of data that have different information sources and spatial resolutions (farms, irrigation consortia, counties). Considering that the data take into account the influence of cropping techniques and territorial characteristics on the irrigation water volume used for rice, the database could be used to allocate the water consumption need for irrigation at farm level for cultivation of rice in a more realistic way than deterministic simulation models. This work was developed within a project called MARSALa (Modelling Approach for irrigation water eStimation at fArm Level), founded by Eurostat, focused on the development of a calculation model for the estimation of the irrigation consumption at farm level.*

Keyword: irrigation

Riassunto: *Il contributo riporta i risultati preliminari di un'indagine sul volume medio ad ettaro di acqua impiegato per la coltivazione del riso a scala nazionale. Lo studio è finalizzato alla costruzione di un database nazionale, con risoluzione comunale, sui volumi di acqua impiegati mediamente nel ciclo di sviluppo della coltura. La metodologia per la realizzazione del database è basata sulla raccolta, armonizzazione ed estrapolazione di dati che hanno fonti informative e risoluzione diverse (aziendale, consortile e provinciale). Il database, rispecchiando le caratteristiche territoriali e le tecniche agronomiche adottate, potrà essere utilizzato per imputare i consumi irrigui aziendali per la coltura del riso in maniera più realistica rispetto a quella realizzabile con modelli deterministici di simulazione. Il lavoro è stato sviluppato nell'ambito del progetto MARSALa (Modelling Approach for irrigation water eStimation at fArm Level) che ha l'obiettivo di realizzare un modello di calcolo per la stima dei consumi irrigui a livello di singola azienda agricola.*

Parole chiave: irrigazione, volumi irrigui

INTRODUCTION

Italy is the first European producer of rice, exceeding by extension all other European countries, with highest latitude of cultivation area in the world (G. Luppi et al., 2000). Rice cultivated area in 2009 was about 238,000 hectares, while the total raw production reached 1,500,000 tons. Generally the rice cultivated areas reflect the large water availability and the efficiency of water delivery network.

In Italy the rice crop sector is traditionally made in the Po valley, Center – West in the left bank of the Po river. However, other regions such as Emilia Romagna, Veneto, Friuli Venezia Giulia, Tuscany, Sardinia and Calabria present interesting areas where rice is cultivated.

Irrigation is done mainly by flooding irrigation therefore soil preparation before planting is a crucial step of the rice cultivation. Two types of preparation for rice fields can be found in Italy depending on soil characteristics, topography, and

size and distribution of farm parcels: one is widespread in the western Po Valley (Piemonte and Lombardia), the other in the eastern Po Valley (Mantova province and in the provinces of Emilia Romagna and Veneto). The first one is typical of farms with small extension and with parcel slope not negligible. In this case the area of the cultivation units, so called rooms, is relatively small (2-3 Ha or less). The second one is diffused in Veneto and Emilia Romagna region where rice parcels have large surfaces (10-12 Ha on average). In this case field are naturally flat and are bordered by large banks also used as dirt roads used as access to cultivated fields.

There are two main irrigation techniques: flooding and dry condition. These two irrigation techniques are often applied with several variations strongly affecting the management of an irrigated district. Flooding is traditionally used in the whole rice territory of Padana Plain. It consists in covering the cultivated field with a water stratum having a depth ranging from 5 to 20 cm and lasting for the majority of the growing cycle (generally from the end of March till the end of October depending on the

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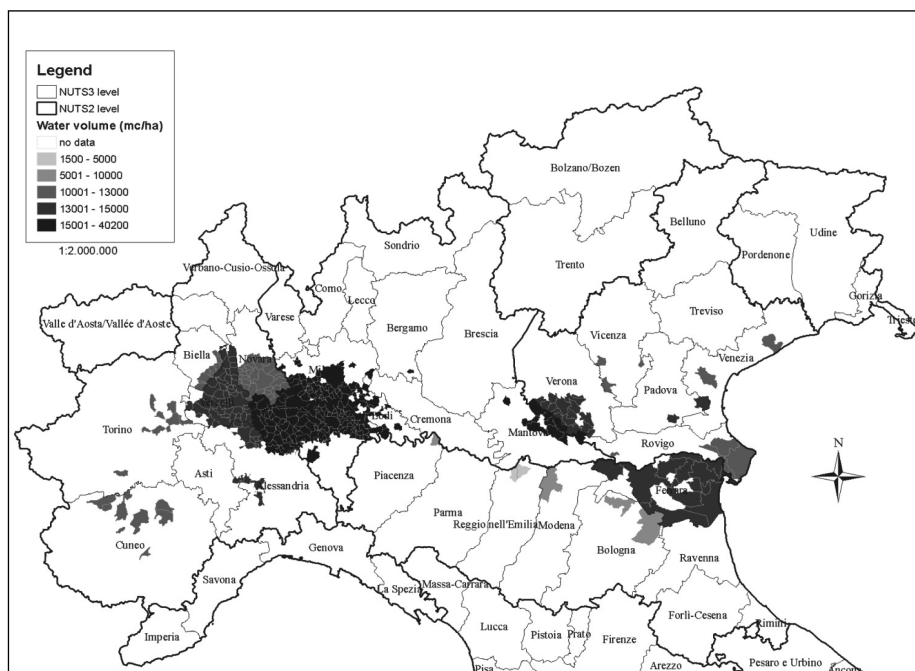


Fig. 1 - Average volumes of irrigation water applied for rice cultivation in Northern Italy, from INEA.

Fig. 1 - Volumi medi di acqua utilizzati per l'irrigazione del riso nel Nord Italia, da INEA.

variety of rice). Traditionally the seeding is disperse over a field already flooded but, in the recent years is being used the seeding on the dry field. In this case the flooding can be immediately after seeding, or in a later phase once herbicides have been spread.

Rice cultivated with dry condition is based on a periodical irrigation where the cultivation rooms are flooded with a water depth of 5-10 cm left to infiltrate till the complete absorption. This allows the full supply of water in the root zone. The length of flooding and drying periods is different, this depends on a function of soil texture, while rainfall can reduce the number of irrigations required to complete the growing cycle. Rice can be cultivated without flooding as other cereals only where the pluviometric regime reaches a minimum threshold of 900-1000 mm in an interval of 3-5 months. The optimal thermal conditions are between 18 and 33 °C.

Given the economic importance of rice, peculiar water needs and taking into account the objective of the proposed model by MARSALA in order to estimate the irrigation volume used at municipalities scale (Lupia et al., 2009), the following study was carried out to build a national database which local resolution of data, the volume of water used for the growing cycle of the crop. The need to build a national database was justified by, first of all, the lack of soil data and lack of high resolution climate data for rice –

cultivating areas that allow accurate simulations through the classical models.

The database will be used to assign the water consumption of rice crop to farm parcel surveyed by the agricultural census 2010 (ISTAT).

MATERIALS AND METHODS

The cropping techniques and territorial characteristics influence the volumes of the irrigation water used for rice. Therefore a different approach was followed for the comparison of the results.

The approach consisted on the creation of a national database of the average irrigation water volumes (measured in m³/Ha) used for rice cultivation and by producing data at municipality level (LAU-2). This was considered an optimal solution both in terms of software computational efficiency and reliability and accuracy of the estimated values.

Database creation was done through a pilot survey for the Italian provinces (NUTS 3¹) where rice is cultivated. The activity was divided into the following steps:

1. Inventory of the municipalities where rice is cultivated;
2. Data collection on the irrigation water consumption through surveys on different subjects (Irrigation Cosortia, FADN²);
3. Imputation of an average irrigation water

Tab. 1 - Structure of the national database on the irrigation water volumes used for rice cultivation.

Tab. 1 - Estratto Database Nazionale sui volumi di acqua (m³/ha) utilizzati per la coltivazione del riso.

Regions	Provinces	Average irrigation water (m ³ /ha)	Source ^v
Veneto	Verona	15000	1
Veneto	Venezia	10500	2
Toscana	Siena	1500	4
Lombardia	Pavia	40000	2
Emilia Romagna	Bologna	9000	6

1: data acquired at provincial level provided by technicians of Irrigation Consortia.

2: data acquired at Irrigation Consortia level provided by technicians.

3: data acquired at municipality level provided by and FADN enumerators.

4: data acquired at farm level provided by technicians of Irrigation Consortia and FADN surveyors.

5: data acquired at irrigation district level provided by technicians of FADN enumerators.

6: data extrapolated as average of the values of the nearby provinces with similar characteristics.

consumption volume to each municipality and creation of the database.

1. The municipality was identified through the database provided by the Ente Nazionale Risi³, referring to the year 2009. The mentioned database was considered reliable since all farmers cultivating rice are obliged to communicate annually the cultivated areas to the Ente Nazionale Risi. The database contains surfaces and location (in terms of municipality and province) of rice cultivated areas. The allocation of a cultivated area to a municipality is based on the geographical location of the farm centre rather than the actual location of rice parcels.

2. The municipalities were associated to the areas served by irrigation consortia in order to identify the main actors dealing with irrigation management to be considered as potential respondent to the survey.

The data collection for irrigation water consumption was performed by interviewing both Irrigation Consortia's technicians having an extensive knowledge of the areas served by the Irrigation Consortia and of the water consumptions as well as FADN's enumerators operating in the provinces where rice cultivation was identified. All the values collected had to be considered as expert's evaluation. Sardinia was treated differently by exploiting more accurate

data coming directly from measurement devices available inside the irrigation district managed by the oristanese Irrigation Consortia.

3. The collected data have different spatial resolution ranging from the data measured at farm level by measurement devices (Sardinia) to data estimated by experts at municipality, Irrigation Consortia or province level. The collected information was processed in order to build a national database by extrapolating the data at municipality level.

For the municipalities where it was not possible to acquire any data through the interviews, the average water consumption of the relative province or of the near provinces with similar characteristics was attributed.

Tab. 1 shows the structure of the database. It contains the administrative reference of the areas with rice cultivation (region, province and

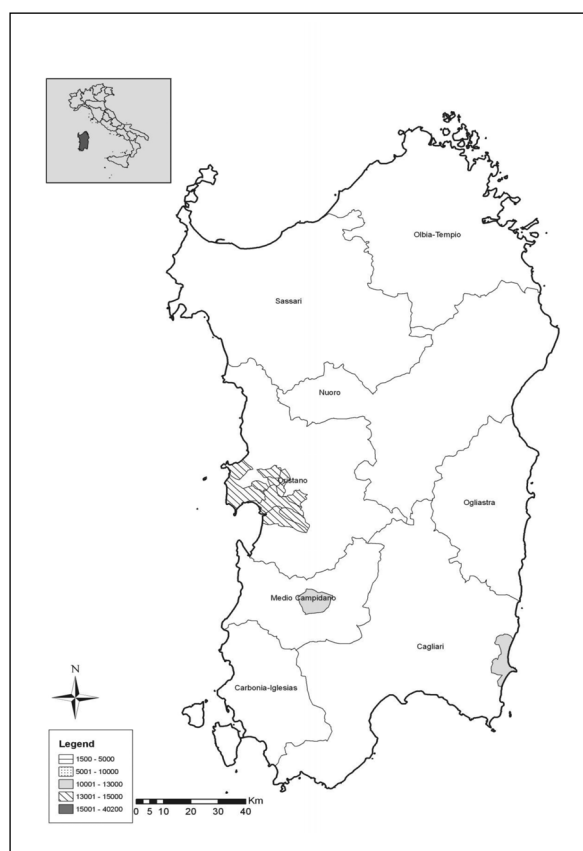


Fig. 2 - Average volumes of irrigation water applied for rice cultivation in Sardinia region, from INEA.

Fig. 2 - Volumi medi di acqua utilizzati per l'irrigazione del riso in Sardegna, da INEA.



Fig. 3 - Average volumes of irrigation water applied for rice cultivation in Toscana region, from INEA.

Fig. 3 - Volumi medi di acqua utilizzati per l'irrigazione del riso in Toscana, da INEA.

municipality), the average water consumption extrapolated at municipality level and a code indicating the source of the information. The values show water consumption varying among municipalities from a minimum of 1,500 m³/Ha in Tuscany to a maximum of 40,200 m³/Ha in Lombardia. The strong variability can be explained by the diversity of soil, cultivar and irrigation techniques (Fig. 1; Fig. 2; Fig. 3).

CONCLUSIONS

The database created can be considered a valuable tool for carrying out analysis of the spatial distribution of the water used for rice cropping.

In addition the knowledge of the water consumption at territorial level is an useful tool for water managers, especially when water shortage requires a precise allocation among the different users.

NOTE

¹ The Nomenclature of territorial units for statistics, abbreviated as NUTS. Nuts 2 municipalities, Nuts 3 provinces

² Farm Accountancy Data Network

³ Italian official institute addressed in collecting national data on rice cultivated areas about the surfaces used for rice cultivation

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DISCLAIMER

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