

**DEVELOPMENT OF AN INTEGRATED SYSTEM TO IDENTIFY AND
MONITOR NITRATES VULNERABLE ZONES (ZVN) IN APULIA REGION:
A TOOL TO SUPPORT PLANNING ACTIVITIES AIMED TO REGIONAL
WATER RESOURCES PROTECTION**
*SVILUPPO DI UN SISTEMA INTEGRATO PER L'IDENTIFICAZIONE
ED IL MONITORAGGIO DELLE ZONE VULNERABILI AI NITRATI
DI ORIGINE AGRICOLA (ZVN) IN PUGLIA:
STRUMENTO A SUPPORTO DELLE ATTIVITÀ DI PIANIFICAZIONE DEL
TERRITORIO FINALIZZATE ALLA TUTELA DELLE RISORSE IDRICHE REGIONALI*

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Abstract

The “91/676/CEE” Directive on the protection of waters against pollution caused by nitrates from agricultural sources provides guidance on controls and actions to be implemented to reduce the pollution caused by nitrates from the manure and/or the massive use of fertilizers. This Directive has been transposed at national (D.Lgs. 152/99 and D.Lgs. 152/06) and regional (D.G.R. n° 2036/2005 for the Puglia Region). Following the first four years of water bodies monitoring, the Puglia Region to comply with European obligations has been looking after the auditing and updating of the Nitrates Vulnerable Zones (ZVN). To this aim, it has been carried out in collaboration with the CNR-IRSA of Bari, a detailed study using appropriate information systems for geo-spatializing datasets. The main goal of this work was to develop an integrated system for the identification and monitoring of ZVN also useful to support regional planning actions through spotting opportune mitigation strategies against nitrates pollution phenomena, that have been adopted in the new “Nitrates Action Plan”.

Keywords: integrated system, monitoring, nitrates pollution.

Parole chiave: sistema integrato, monitoraggio, contaminazione da nitrati.

Introduction

The Nitrates Directive (91/676/EEC) – Council Directive of 12 December 1991 concerning the protection of waters against pollution by nitrates from agricultural sources – has the objective of reducing water pollution caused or induced by nitrates from agricultural sources. In accordance with this Directive each Member State has been obliged to put in place a Nitrates Action Programme (PAN) and to review and if necessary revise their Action Programme at least every four years.

In Italy this Directive has been transported at national for the first time in 1999 (D.Lsg. 152/99) and in the second time in 2006 (D.Lgs 152/06). In 2005 Apulia Region has approved the first Nitrates Action Plan (PAN) in which it was indicated the first designation of the Apulian Nitrates Vulnerable Zones (D.G.R. n° 2036). These areas have been confirmed in 2010 (D.G.R. n° 1317/2010). In 2012 all the Italian Regions are called to present a reviewed PAN, therefore for this scope Apulia Region in collaboration with the CNR-IRSA of Bari, has carried out a study to develop an integrated system able to support the actions of Nitrates Vulnerable Zones (ZVN) identification and monitoring and also to discover new suitable policy instruments useful to improve water bodies quality and management.

Materials and Methods

In order to investigate the pollution caused by nitrates from the manure and/or the massive use of fertilizers on Apulia

groundwater we use datasets provided by three different monitoring networks existing on apulia land (ARPA Puglia, ASSOCODIPUGLIA, TIZIANO) which control periodically 472, 429 and 372 wells, respectively.

The nitrates concentrations (mg/L) of the four years 2008-2011 have been considered and spatialised using a GIS system (PERIMSITI sft). During 2012 a targeted sampling of the monitored wells characterized by high nitrates values (> 50mg/L) has been carried out. The use of PERIMSITI software allowed to manage several datasets analyzing at the same time different themes such as land use (Corine Land Cover, 2006), soil lithology, altimetry, texture, regional caves cadastre (Regione Puglia, 2012), etc.

Moreover the study has made use of the data warehouse of the 6th General Census of Agriculture (ISTAT, 2012) which contains a wealth of detailed information on the structure of Italian agricultural and livestock holdings, broken down to municipal level, referring to the period 2000-2010. This dataset was used to calculate and modeling nitrogen loads on territory related to agriculture activities.

Result and Discussion

The GIS elaborations allowed to: (I) confirm some vulnerable areas just identified in 2005 (71.098 ha), delete areas not more polluted by nitrate from agricultural sources (20.957 ha), (III) identify new nitrates polluted areas (14.746 ha). Lastly, the

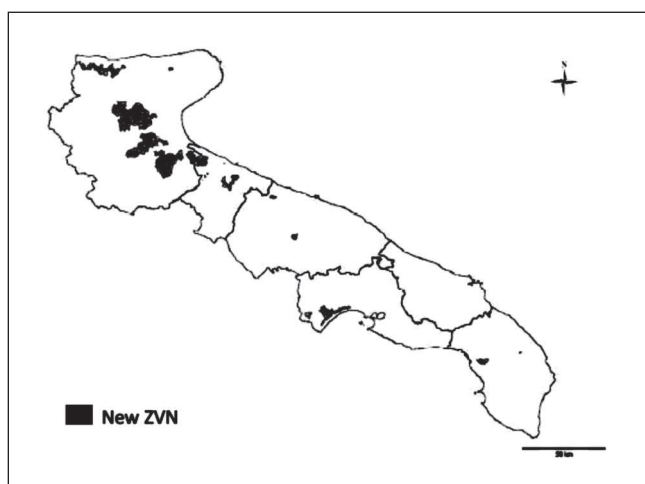


Fig. 1 - New identification of Nitrates Vulnerable Zone in Apulia Region.

Fig. 1 - Nuova individuazione delle Zone Vulnerabili a Nitrati in Puglia.

Tab. 1 - Dataset of data warehouse of the 6th General Census of Agriculture (ISTAT, 2012) referred to Taranto province.

Tab. 1 - Dataset dei dati di warehouse del 6th Censimento generale dell'Agricoltura (ISTAT, 2012) della provincia di Taranto.

Type of Farming	n° heads of livestock (ISTAT 2000)	n° heads of livestock (ISTAT 2010)
Aviculture	203 .235	129.929
cattle	43.297	44.443
Buffalo	2	53
goat	9.662	10.808
rabbits	24.346	35.437
equines	1.919	2.969
sheep	23.478	31.080
ostriches	0	5
pigs	2.525	4.409
beekeeping	-	943

areas to be monitored for the next four years have been identified (42.635 ha) as showed in Tab. 1. The new Nitrates Vulnerable Zones (ZVN) in the Apulia Region are 85.855 ha, this extension is less than of the one designed in 2005 (92.057 ha). Also the monitoring areas are less than of those identified in 2005 equal to 42.324 ha (data not shown).

Data analysis of the number of livestock's unit for the different existing type of farming Taranto province for the period 2000-2010 has allowed to highlight increments of number of livestock's units, especially for pigs, sheep and rabbits suggesting that in this province an increase in farming activities has occurred. It could justify the increment of the nitrates polluted areas (1100 ha) in this provincial territory.

Conclusion

Nitrate leached from intensive agriculture is an important pollutant of waterways throughout the world (Stout et al., 2000; Singh & Sekhon, 1979). Therefore with this study we have developed an integrated system to support the identification and monitoring of nitrates vulnerable areas. Results have showed that globally the ZVN decreased compared to 2005 and it was correlated to the agricultural and farming activities occurred on the regional land that have changed in the examined period. Moreover this system has allowed to identify new opportune mitigation strategies, such as the use of establish of new generation system for the treatment of livestock wastewater, that have been adopted in the new "Apulian Nitrates Action Plan" aimed to further reduce Apulian ZVN and to restore quality of water bodies.

References

- CORINE Land Cover for Europe, 2006. CoORDinated INformation on the Environment. CEC, <http://www.sinanet.isprambiente.it/it/coperturasuolo>.
- D.G.R. n. 2036 del 30.12.2005- "Direttiva 91/676/CEE relativa alla protezione delle acque dall'inquinamento provocato da nitrati provenienti da fonti agricole. "Designazione" e "Perimetrazione" delle "Zone Vulnerabili da Nitrati di origine agricola".
- D.G.R. n. 1317 del 03.06.2010 - "Conferma *designazione e perimetrazione Zone Vulnerabili ai Nitrati* Attuazione della direttiva 91/676/CEE relativa alla protezione delle acque dall'inquinamento provocato da nitrati provenienti da fonti agricole".
- D.Lsg. 152/99. Norme in materia ambientale.
- D.Lgs 152/06. Regolamento concernente la fissazione di standard di qualità nell'ambiente acquatico per le sostanze pericolose.
- ISTAT, 2010, 6[^] Censimento Generale dell'Agricoltura, <http://dati-censimentoagricoltura.istat.it/>.
- Regione Puglia, 2012. "Catasto delle grotte e delle cavità artificiali", PO FESR 2007-2013, Linea 4.4, Azione 4.4.1, attività E, Attuazione della L.R. 33/09.
- Singh B. and Sekhon G.S., 1979. Nitrate pollution of groundwater from farm use of nitrogen fertilizers –a review. *Agriculture and Environment*, 4, p. 207-225.
- Stout W.L., Fales S.L., Muller L.D., Schnabel R.R., Weaver S.R., 2000. Water quality implications of nitrate leaching from intensively grazed pasture swards in the northeast United States. *Agriculture, Ecosystems and Environment*, 77, p. 203-210.