World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:9, No:07, 2015

Importance of Different Spatial Parameters in Water Quality Analysis within Intensive Agricultural Area

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Abstract : Even though European Council Directive 91/676/EEC known as Nitrates Directive was adopted in 1991, the issue of water quality preservation in areas of intensive agricultural production still persist all over Europe. High nitrate nitrogen concentrations in surface and groundwater originating from diffuse sources are one of the most important environmental problems in modern intensive agriculture. The fate of nitrogen in soil, surface and groundwater in agricultural area is mostly affected by anthropogenic activity (i.e. agricultural practice) and hydrological and climatological conditions. The aim of this study was to identify impact of land use, soil type, soil vulnerability to pollutant percolation, and natural aquifer vulnerability to nitrate occurrence in surface and groundwater within an intensive agricultural area. The study was set in Varaždin County (northern Croatia), which is under significant influence of the large rivers Drava and Mura and due to that entire area is dominated by alluvial soil with shallow active profile mainly on gravel base. Negative agricultural impact on water quality in this area is evident therefore the half of selected county is a part of delineated nitrate vulnerable zones (NVZ). Data on water quality were collected from 7 surface and 8 groundwater monitoring stations in the County. Also, recent study of the area implied detailed inventory of agricultural production and fertilizers use with the aim to produce new agricultural land use database as one of dominant parameters. The analysis of this database done using ArcGIS 10.1 showed that 52,7% of total County area is agricultural land and 59,2% of agricultural land is used for intensive agricultural production. On the other hand, 56% of soil within the county is classified as soil vulnerable to pollutant percolation. The situation is similar with natural aquifer vulnerability; northern part of the county ranges from high to very high aquifer vulnerability. Statistical analysis of water quality data is done using SPSS 13.0. Cluster analysis group both surface and groundwater stations in two groups according to nitrate nitrogen concentrations. Mean nitrate nitrogen concentration in surface water – group 1 ranges from 4,2 to 5,5 mg/l and in surface water – group 2 from 24 to 42 mg/l. The results are similar, but evidently higher, in groundwater samples; mean nitrate nitrogen concentration in group 1 ranges from 3,9 to 17 mg/l and in group 2 from 36 to 96 mg/l. ANOVA analysis confirmed statistical significance between stations that are classified in the same group. The previously listed parameters (land use, soil type, etc.) were used in factorial correspondence analysis (FCA) to detect importance of each stated parameter in local water quality. Since stated parameters mostly cannot be altered, there is obvious necessity for more precise and more adapted land management in such conditions.

Keywords : agricultural area, nitrate, factorial correspondence analysis, water quality
Conference Title : ICSWRM 2015 : International Conference on Sustainable Water Resources Management
Conference Location : Stockholm, Sweden
Conference Dates : July 13-14, 2015