

IV. CONCLUSION

Results showed us that land altitude, water table properties, and differences of agricultural practices among the greenhouse regions may be affective on contamination characteristics of groundwater.

Physico-chemical characteristics except EC values of groundwater in the majority of greenhouse areas were within the acceptable limit values and differences in characteristics among the regions were found statistically important. High nitrate contents of groundwater due to agricultural activities all season in greenhouse regions seem the main threats for public health. According to this, control of nitrate pollution in groundwater especially in greenhouse areas requires a holistic approach to climate land, aquifer and land use factors.

According to metal evaluation parameters, generally, it can be concluded that most of groundwater in Kaş region may be considered less contaminated. However, data also showed that there was an alarming rate of NO₃ and heavy metal pollution risks in some sampling sites. Results showed us that soil metal fractions and soil metal mobility factor were also effective on groundwater metal contamination.

ACKNOWLEDGEMENT

This research was sponsored by TUBITAK (The Scientific and Technological Council of Turkey). Author would like to thank to TUBITAK for the financial support of the project (TOVAG-1110711).

REFERENCES

- [1] Suthar, S., P. Bishnoi, S. Singh, P.K. Mutiyar, A.K. Nema *et al.* 'Nitrate contamination in groundwater of some rural areas of Rajasthan, India', *J. Hazard. Mater.*, 2009, 171: 189-199.
<https://doi.org/10.1016/j.jhazmat.2009.05.111>
- [2] Khan, I., H. Ullah, M. Imran. 'Nitrate and phosphate pollution in surface and ground water in Western Malaysia', *J. Chem. Soc. Pak.*, 2007, 29: 315-320.
- [3] Cruz, J.V., Silva, M.O., Diaz, M.I., Prudencio, M.I. 'Groundwater composition and pollution due to agricultural practices at sete cidades volcano (Azores, Portugal)', *Applied Geochemistry*, 2013, 29:162-173.
<https://doi.org/10.1016/j.apgeochem.2012.11.009>
- [4] Heaton, T., Stuart, M., Sapiano, M., Sultana, M. 'An isotope study of the sources of nitrate in Malta's groundwater', *J. Hydrology*, 2012, 414(415):244-254.
<https://doi.org/10.1016/j.jhydrol.2011.10.037>
- [5] Mahvi, A.H., J. Nouri, A.A. Babei, R. Nabizadeh. 'Agricultural activities impact on groundwater nitrate pollution'. *Int. J. Environ. Sci. Tech.*, 2005, 2: 41-47
<https://doi.org/10.1007/BF03325856>.
- [6] Clesceri, L., Greenberg, A.E., Eaton, A.D. 'Standard Methods for the Examination of Water and Wastewater, 20th edition', American Public Health Association, 1998, Washington, DC.
- [7] APHA, 'Standard Methods for the Examination by Water Waste Water', 16th Edn. APHA, 1985, Washington.
- [8] ISO 11466 International Standard. 'Soil quality-extraction of trace elements soluble in aqua regia', 1995,03-01.
- [9] Tessier, A., Campbell, P.G.C., Bison, M., 1979. Sequential extraction procedure for the speciation of particulate trace metals. *Anal. Chem.* 51, 844-851.
<https://doi.org/10.1021/ac50043a017>
- [10] Soon, Y.K., Abboud, S., 1990. Trace elements in agricultural soils of North-western Alberta. *Can.J. Soil Sci.* 70, 277-288.

- <https://doi.org/10.4141/cjss90-029>
- [11] Mohan, S.V., Nithila, P., Reddy, S.J. 'Estimation of heavy metal in drinking water and development of heavy metal pollution index. *J. Environmental Sci. Health*', 1996, 283-289.
 - [12] Edet, A.E., Offiong, O.E. 'Evaluation of water quality pollution indices for heavy metal contamination monitoring. A study case from Akpabuyo-Odukpani area, Lower Cross River Basin (southeastern Nigeria)', *Geojournal*, 2002, 57, 295-304.
<https://doi.org/10.1023/B:GEJO.0000007250.92458.de>
 - [13] United States, Environmental Pollution Agency (USEPA), 'Integrated risk information system', 2007. Available from: (<http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList>).
 - [14] Xu, X., Zhao, Y., Zhao, X., Wang, Z., Deng, W. 'Sources of heavy metal pollution in agricultural soils of a rapidly industrializing area in the Yangtze delta of China', *Ecotoxicology and Environmental Safety*, 2014, 108, 161-167.
<https://doi.org/10.1016/j.ecoenv.2014.07.001>
 - [15] Hakanson, L. 'An ecological risk index for aquatic pollution control: A sedimentological approach', *Water Research*, 1980, 14: 975-1001.
[https://doi.org/10.1016/0043-1354\(80\)90143-8](https://doi.org/10.1016/0043-1354(80)90143-8)
 - [16] C.E.C. (Council of the European Communities) 1986. Directive of 12 June 1986 on the protection of the environment, and in particular of the soil, when SS is used in agriculture (86/278/CEE). *Official Journal of the European Communities*, L181, 6-12.
 - [17] WHO 'Guidelines for Drinking-Water Quality', Vol. 1, 2000-recommendations, 3rd ed. Geneva: World Health Organization, 2006.