

Application of GIS in the Mapping of Petrochemical–Induced Groundwater Contamination from Underground Fuel Storage Tank Leakages in Ile-Ife, Southwestern Nigeria

Adeoti O. F.¹, Akinluyi F.O.^{2*}, Isimekhai K.A.¹, Anifowose A.Y.B.², Komolafe A.²

¹Department of GIS, Regional Centre for Aerospace Surveys, Obafemi Awolowo University, Ile-Ife, Nigeria

²Department of Remote Sensing and GIS, Federal University of Technology, Akure, Nigeria

^{2*}Corresponding author: foakinluyi@futa.edu.ng

Abstract

Petrochemical-induced groundwater contamination was investigated using an integrated GIS and physico-chemical properties of sampled hand-dug wells close to fuel stations in Ile-Ife, Southwestern Nigeria. This was with a view to evaluating the influence of hydrocarbon spills on groundwater resources within the vicinity of the supposedly leaking underground fuel tanks. Topographic map and IKONOS image of the study area were acquired. Samples from forty-two (42) fuel stations and thirty (30) hand-dug water wells were analyzed for organic compounds such as benzene, ethylbenzene, toluene, xylene, and 1,2,4 trimethylbenzene using gas chromatography and mass spectrometry. Geographic Information System (GIS) tools were employed to examine the spatial relationships between the contaminants and to characterize their levels within the study area. Spatial analysis operations such as spatial interpolation, raster based reclassification, buffering and map overlay were employed. The results obtained were compared with World Health Organization (WHO) standards. Results indicate the presence of benzene in all the water wells with concentrations ranging from 0.004 to 0.09 mg/l; pH, ethylbenzene, toluene, xylene and trimethylbenzene have their highest values at 7.5, 0.074mg/l, 0.031 mg/l, 0.048 mg/l and 0.062 mg/l respectively, while the electrical conductivity varies between 64 and 1538 μ S/cm. Contaminations from these petrochemical components were evident throughout the study area; of most significance is the increasing concentration level of benzene and electrical conductivity which exceeded the WHO standard. Obafemi Awolowo University (OAU) Campus, though not host to many fuel stations, appeared to contain moderately high levels of the organic compounds, which can be attributed to the improper disposal of chemicals used in laboratory experiments, and leakages from underground fuel storage tank in the Power House. The study concluded that most of the hand-dug wells close to fuel stations in Ile-Ife, Southwestern Nigeria are contaminated.

Keywords: GIS, Groundwater, Petrochemicals, Organic Compounds, Contamination.