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Watershed-scale nonpoint source pollution modelling: a case study of Deoha-Garrah agricultural watershed.

Groundwater generally is not easily contaminated but once contamination occurs, it takes long to remove it. However, watersheds with modern agriculture are highly vulnerable to nitrate contamination. Vulnerability assessment of aquifers is generally carried out by traditional methods using ground-based data employing DRASTIC model at very small scale. Watershed-scale applications of the DRASTIC are few and far between. Further, there is general impression that remote sensing techniques look at the surface or few centimetres below. For groundwater vulnerability mapping one has to use geophysical tools. Agreeing in part with this general impression, this paper attempts to develop a remote sensing based methodology to work out all the parameters of the DRASTIC model except the aquifer media (hydrogeology) for which ground-based generated data are used.
Watershed characteristics such as land use/land cover, slope, and soil attributes, depth of groundwater level etc. affect water quality by regulating amount and rate of leaching of contaminants. Hydrological soil classification, impact of vadose zone is computed by mathematical modelling of vadose zone on the basis of root zone soil moisture assessment by remote sensing instead of hydrogeological data. Remotely sensed data have been reinforced by ground-truths testing. Ground truths have been collected from random points generated in GIS environment of each category of all variables. The necessary statistical and mathematical relationships between ground truths and experimental data with those generated by digital image interpretation have been established for generalisation over watershed scale. The layers of different variables in accordance to the methodology of the DRASTIC have been prepared and overlaid in the GIS environment. This exercise generated a map of watershed visualising areas vulnerable to contamination to different degrees. Again random points for each level of vulnerability have been generated and water samples from the nearest dug wells have been collected and analysed for nitrate pollution. The experimental results validated largely the vulnerability assessment carried out by employing the above mentioned methodology. At the stage of image interpretation uncertainty analysis has been carried out for every classification of watershed for extracting necessary variables using Kappa coefficient and after delineation of vulnerability level zones. A sensitivity analysis has also been carried out to make sure whether some layers may be excluded or not in the process of delineation of vulnerability zones.