ABSTRACT

Characterization and evaluation of factors affecting water and soil quality of Nira river basin, Maharashtra, India

Due to over exploitation and developmental activities potable water is becoming a major concern. The main sources which are polluting fresh water in India are domestic sewage, industrial wastes and intensive agriculture. Most of the rivers have become the end points of effluents discharged from the industries and cities. Since these effluents are not treated as per standard methods pollute surface water and sub-surface aquifers. The impacts are evident from various types of water borne diseases. Along the banks of river Nira there is rapid agricultural and industrial development and being close to Pune, cultivation of cash crops and agro based industries further add to the issue of soil and water quality.

With this background, an assessment of surface and groundwater quality of Nira river basin and soil nutrient status was undertaken. The present study was aimed to focus on the contamination of surface water and groundwater of Nira river basin at different locations during the period October 2009- May 2011. The study was further aimed the investigation of soil in Nira river basin to know the fertility status.

The work was carried out under the following lines:

1. Physico-chemical analysis of surface water and groundwater using standard procedures as per APHA (2005)

2. Analysis of heavy metals Fe, Mn, Ni, Cr, Zn, Cu and Pb in water

3. Analysis of soil using standard procedures of Jackson (1967)

4. Interpretation of the results of water analysis using Piper tri-linear plots and correlation analysis
5. Evaluation of drinking and irrigation water quality

6. Interpretation of the results of soil analysis to determine fertility status

The present thesis is divided into six chapters.

The first chapter introduces sources of surface water and groundwater, importance of potable water, water scenario of India and Maharashtra, water resources in the district. Factors controlling the surface water and groundwater quality, major water pollutants, point and non-point sources of water pollution are mentioned. Information of nature of soils in Maharashtra is incorporated. The significance of the study, aims and objectives are specified.

The second chapter deals with a detailed literature review based on physico-chemical assessment of surface water and groundwater, factors deciding the water quality and sources of pollutants and heavy metals. Literature review for soil analysis was carried out on the basis of sources of nutrients, effect of nutrients on various crops and interpretation of soil. Literature review was done considering the work at national and global level. From the literature review, it is concluded that there is a need of monitoring of water quality, generation and interpretation of data and compare the changes in water quality with time.

The third chapter focuses on the characteristics of Nira river basin as the study area. Nira river drains in Bhor, Baramati and Indapur tahsils of Pune district. The study area is situated in the Pune district of Maharashtra state, India. Systematic location, drainage pattern and thorough information of the study area is incorporated in the chapter.

The fourth chapter highlights on the materials and methods used for the assessment of water quality. Describing the boundaries of the study area, sampling sites were located for collection of water and soil samples. GPS was used for location in this study along with topographic maps. Total 23 locations for surface water and 10 locations for groundwater were selected. Groundwater samples include 5 dug wells and 5 bore wells. pH and estimation of D.O. of water samples was done immediately after the collection. Instrumental analyses in combination
with analytical methods are used for water analysis. The analysis of water samples in the laboratory was carried by standard method given by APHA. Results and discussion of the generated data is included in the second part. With the help of literature the results are interpreted and discussed. The drinking and irrigation water quality in the study area is discussed by using conductivity, TDS, total hardness and sodium adsorption ratio (SAR). Water quality is explained by generating correlation matrix. The outcome of the results indicated strong positive correlation between E.C. and TDS for surface water. On the same line, strong positive relation between Na and Cl supported the fact of addition of anthropogenic inputs. For groundwater, positive correlations between E.C. – TDS, Mg – Cl, Mg – SO$_4$, Na – Cl and Na – SO$_4$ indicated existence of chlorides and sulphates of Mg and Na in groundwater. Piper tri-linear plots are used for evaluation of dominant facies and water types. The water type for most of the surface and groundwater samples was Ca – HCO$_3$. The results are supported by indicating possible sources of contamination in the study area. High conductivity TDS, chloride, sulphate values in the downstream part indicates deterioration of water quality. The increase in the degree of contamination of surface water from upstream to downstream area is explained by various human activities taking place at river banks, the impact of agricultural activities, untreated industrial effluents, sand mining activity and domestic waste. Possible contamination of groundwater was due to percolation of leachate from the landfills situated in the vicinity and discharge of industrial waste which mix with the groundwater aquifer system.

The fifth chapter is describing the materials and methods used in analysis of soil. Total 24 samples were collected from various locations of the study area. Instrumental and laboratory analysis of soil samples carried out by standard method given by Jackson (1967). The results generated are justified by statistical interpretation. Slightly acidic to slightly alkaline pH of most of the soil samples is an indication of good fertility of the soil. Most of the crops grow well for pH 6.0 – 7.5. Soils are slightly calcareous in nature. The nutrient status on the basis of nitrogen, phosphorous and potassium indicate slightly low available K$_2$O. On the basis of organic carbon and major nutrients it was concluded that the soils are fertile in the study area. All the soils indicate low calcium content and most of the
samples indicate optimum magnesium content. Adequate amount of sulphur was
detected in the soil. Amongst the heavy metals, concentrations of Cu and Mo are
adequate. However, Mn, Fe, Zn and B are present in low concentrations.

The last chapter summarizes the entire work related to water and soil. Drinking water quality is decided on the basis of TDS and CaCO₃. Unsuitability of
surface water for drinking purpose observed in the downstream area. Irrigation
water quality was decided on the basis of electrical conductivity and SAR. Sites
DW14a and BW21 point towards serious groundwater pollution making water
unfit for human consumption and irrigation. Contamination of water with heavy
metals is reported at few places. Water type in the study is described by plotting
Piper tri-linear plots. Water type dominant for surface water are Ca-HCO₃ and
mixed Ca-Na-HCO₃. For groundwater dominant water type is Ca-HCO₃. By
performing the correlation matrix the correlation between the variable were
determined. Strong correlation between EC and TDS was observed for surface
water and groundwater samples. Mg and Na significantly correlated with Cl and
SO₄ representing the existence of chlorides and sulphates of Mg and Na. Slightly
acidic to slightly alkaline nature of the soil showed low calcium content, optimum
magnesium content and adequate sulphate content. Fertility status according to
organic carbon, Nitrogen, Phosphorous and potassium predicts good fertility of the
soil in the study area. Adequate concentrations of Cu and Mo are recorded.

This comparative study reveals the need of proper management of water
resources, monitoring of water quality periodically and comparison of the results
which would help to undertake corrective measures to manage water resources.