GROUNDWATER QUALITY IN MANYATTA AND MIGOSI ESTATES OF KISUMU TOWN

BY

ERASTUS OTIENO ORWA

B.Ed (Sc) HONS

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Of the School of Environmental Studies - Moi University.

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ABSTRACT

This study was aimed at determining the quality of groundwater in shallow wells in Manyatta and Migosi estates of Kisumu town as well as determining the impact of spatial and temporal variation to the quality of the water. Fifteen sampling stations were established in Migosi estate and twenty in Manyatta estate. Samples were collected every fortnight per station and analysed for *Escherichia coli (E.coli)*, Total coliform (T.coli), nitrate, phosphate, sulphate, temperature, Total Dissolved Solids, TDS, electrical conductivity, pH, total hardness, alkalinity, chloride, fluoride, bicarbonate, calcium, magnesium, potassium, zinc, iron, silica, cadmium, lead and copper, over a period of nine months. This period covered wet and dry seasons. The data obtained was statistically treated to produce results.

The study found out that the wells were highly contaminated with *E.coli* and T. coli in Migosi estate (mean 247.77 ± 168.41, 355.21±269.21 counts/100 ml) and Manyatta estate (mean 653.76 ± 349.28, 822.69 ± 355.82 counts/100 ml) when compared to Kenya and WHO standards with the mean values in Manyatta estate doubling those of Migosi estate. All wells in Manyatta estate had fluoride levels within permissible levels. 2 wells in Migosi estate had fluoride levels (mean 2.148, 2.152 mg/l) above Kenya and WHO limits. Six of the sampled wells in Migosi and 17 in Manyatta had nitrate levels above permissible limits of WHO (10 mg/L). Similarly, seven of the sampled wells in Migosi and 12 in Manyatta had cadmium levels above permissible limits of WHO (0.005 mg/l) but within Kenyan limits. One well in Manyatta had lead levels (mean 0.102 mg/l) above permissible limits of Kenya standards while three wells had levels above WHO standards. The rest of the parameters were within permissible limits. The study showed that all the parameters

analysed varied significantly with spatial differences. All the parameters except sulphate, lead, and copper in Migosi and conductivity, TDS and iron, in Manyatta estate showed significant variation with temporal changes. Rainfall showed a positively significant correlation with conductivity, fluoride, nitrate, zinc, cadmium, *E.coli* and T.coli in Manyatta and *E.coli*, T.coli, copper, lead and zinc in Migosi estates respectively. Unlike in Migosi estate, *E.coli* and T.coli counts in Migosi and Manyatta estate showed negative correlation with well depth and distance of a well to a pit latrine. In general, Manyatta estate had significantly higher mean values of the parameters investigated than Migosi except for pH, temperature, phosphate, fluoride, zinc, iron, cadmium and copper levels, which showed insignificant differences.

Results of the principal component analysis showed that variation in the levels of *E.coli* and T.coli in Migosi estate observed were heaped on only 3 of the 25 factors that explained 59.92% of the total variance and this corresponded to rock composition, athropogenic activities and temperature respectively. In Manyatta estate, however, 4 of the 25 factors explained 53.62% of the total variance in *E. coli* and T. coli. These factors related to geology, athropogenic activities and rainfall respectively while the fourth factor related to pH, temperature and well depth. As an alternative to the use of pit latrines and septic tanks that pollute groundwater the study recommended the promotion and use of ECOSAN toilets. Additionally, wells that showed levels of heavy metals and physico-chemical parameters above recommended guidelines of Kenya and WHO should be abandoned and sinking of wells in these regions should be banned.