

ABSTRACT

The mobility of nitrate-N ($\text{NO}_3\text{-N}$), nitrite-N ($\text{NO}_2\text{-N}$) and ammonium-N ($\text{NH}_4\text{-N}$) down the soil profile and its ultimate presence in groundwater is aggravated by predisposing conditions such as farm agricultural activities and nitrogen fertilizer management, rainfall, seasons and well sanitary conditions. The main objective of the study was to assess the groundwater nitrogen loading compared in different farm sizes. The study was conducted in three agro-ecological wards of Ainabkoi sub-county. Each ward was identified as a homogenous stratum of same size-ranged farms. Farms in Ainabkoi ward were large, family-generations-owned mixed farm sizes and ranged 40-71 acres (16-29 ha) with an average farm acreage of 56 acres (23 ha). In Kaptagat ward farms were medium sized mixed farms on purchased settlement farms and ranged from 10-35 acres (4-14 ha). The small mixed farm sizes were located in Olare ward and ranged 2-10 acres (0.8-4 ha) in size. Farms in each ward were purposively selected such that only accessible farms that had access to either a privately owned or communal wells were selected. The study was carried out between 2012 and 2013. Onsite sanitary survey of the wells and the homesteads was carried out in each farm. A questionnaire was used to obtain general information on farm production and management, farm sizes, crops grown, crop acreage, cropping calendars, types and number of livestock animals kept, type and amount of fertilizer applied and well characteristics. The nitrate-N, nitrite-N and ammonium-N concentrations did not exceed the recommended maximum concentration by Kenya and WHO of 10mg/l, 3mg/l and 0.5mg/l respectively. The physico-chemical parameters were within the acceptable limits set by WHO except for turbidity. There was a positive linear relationship between the average fertilizer N amount at top dressing and the groundwater nitrate ($Y = 0.0836x - 165.18$ $R^2 = 0.31$), hence N pollution is closely related to the amount and timing of fertilizer application. There were highly significant differences between precipitation and the N concentration although the trends were not clearly recognizable. There was a highly significant positive linear relationship between the monthly rainfall amount and $\text{NO}_3\text{-N}$ concentration in well water ($Y = 0.1759x + 22.07$ $R^2 = 0.23^{***}$). There were highly significant differences between the farm sizes in the sanitary contamination risk scores mainly due to individual farm endowments, well site environmental factors and ownership. Conclusively, precipitation, season and timing of fertilizer application were common significant predictors of the concentration levels of N in well water. The absence of any significant N contamination of groundwater in this study does not preclude it occurring in the future. Best nitrogen fertilizer management strategies should be adopted in order to synchronize N supply with crop seasonal demand such as timing and splitting of fertilizer N application and real-time monitoring of nitrogen in soil, plants and groundwater. Well conformity requirements with regard to the parameters of well construction and its vicinities are necessary.

Keywords

Egerton University