

Salinity of irrigation water in the Philippi farming area of the Cape Flats, Cape Town, South Africa

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ABSTRACT

This paper explores the nature, source and spatial variation of the salinity of water used for irrigation in a coastal urban farming area in Cape Town, South Africa, where water from the Cape Flats aquifer is drawn into storage ponds and used for crop irrigation. Water samples were collected in summer and winter from selected sites across the study area and were analysed for salinity as well as for concentrations of major and minor ions. Each site consists of one borehole and one pond. Isotope analysis was done for the summer samples so as to assess effects of evaporation on water quality and salinity. Descriptive statistics were used to compare the variation in range of concentration of specific ions with the recommended ranges set by the South African Department of Water Affairs and Forestry (DWAF) and the Food and Agriculture Organisation (FAO). Geographical information system (GIS) analysis was used to describe the spatial distribution of salinity across the study area, and hydro-geochemical analysis was used to assess the possibility of seawater intrusion into the aquifer system and to characterise groundwater in the study area. The results of the research showed that the concentrations of chloride, nitrate, potassium and sodium exceeded the target maximum limit according to DWAF and FAO guidelines. Groundwater and pond water were also observed to be brackish in most parts of the research area in terms of total dissolved salts content, and fresh water was only found in the middle section of the research area. It is concluded that the accumulation of salts in groundwater and soil in the study area is mainly due to the agricultural activities and partially due to the natural movement of water through the geological formation of the Cape Flats region. These findings permit the formulation of a conceptual model of the occurrence of the salinization process, which implies that the groundwater and pond water in the study area are generally suitable for irrigation purposes, but need to be used with caution as the vegetables grown are classified as sensitive and moderately sensitive to salt according to DWAF guidelines for irrigation water quality (1996). The research paves a way for possible quantitative simulation of salt mass balance in future.

Keywords: South Africa, Philippi farming area, salinity, groundwater, irrigation water, hydrochemical analysis, isotopic analyses, evaporation, suitability

INTRODUCTION

Water salinity forms a major concern for both water supply and irrigation globally. High salinity levels tend to affect soil structure and crop productivity, mainly through limiting the uptake of water by plants (Khodapanah et al., 2009). Salt contamination can result in adverse and permanent environmental impacts to soil and groundwater resources (Todd and Mays, 2005). There might be many causes of the occurrence and accumulation of salt in the environment. Therefore an understanding of the origin of water salinity is prerequisite for management of irrigation water for both crop productivity and land use. The Philippi farming area in the Cape Flats region of Cape Town, South Africa, as shown in Fig. 1, provides a case study area which is often affected by these salinity issues. It is a vegetable-producing area with its crops being intensively irrigated with groundwater drawn from the Cape Flats aquifer. In the past, several studies were performed in the area but little progress has been made in better understanding the salinity of the water used for agricultural purposes. Therefore, the severity of the spatial and temporal distribution of the salinity

problem is virtually unknown in the study area. Moreover, recent surveys have shown that the Cape Flats aquifer represents an important resource that could potentially be exploited as a municipal water supply in order to alleviate water shortages frequently experienced by the municipality of Cape Town (Wright and Conrad, 1995; Adelana et al., 2006; Seward et al., 2009). It is therefore important to monitor water resources in the Cape Flats region, especially in the areas where the aquifer system seems vulnerable to any kind of pollution, in order to maintain the water quality of the Cape Flats aquifer within the recommended standard levels for the various water uses. In this paper, the chemical analysis data for major and minor ions were used to investigate the nature, source and extent of the salinity of the water used for irrigation in the Philippi farming area, and to assess the suitability of the water for irrigation activities. To cater for the effect of evaporation on the water resources in the study area, stable isotope data were used to refine a conceptual model. Based on the conceptual model, plausible origins of the salinity problem encountered in the Philippi farming area are discussed and put forward.

Location of the study area and its land use

The Philippi area is situated on the sandy Cape Flats, about 14 km from Cape Town, Western Cape, South Africa (latitudes

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