Long-term Changes of Shallow Groundwater Level and Salinity in the Lower Seyhan Plain, Turkey

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1. Introduction

Lower Seyhan Irrigation Project (LSIP) is one of the largest irrigation projects in Turkey which extends on the delta plain of Seyhan river basin with a total planned area of 175,000 ha. With the water supply from the big reservoirs in the upper stream, gravity irrigation is conducted with water efficiency lower than 50%. Before the implementation of the project, wheat and cotton were cultivated with winter rainfall and residual soil water, respectively. When State Hydraulic Works (DSİ) started to implement the irrigation project in this area in the 1960s, the biggest challenge for the engineers was to deal with bad drainage and salinity problems widespread on the delta. Therefore implementation of irrigation was coupled with installation of subsurface drainage and construction of drainage canal networks.

By the 1980's, implementation of the project was complete in two thirds of the total surface area (133,000ha) and DSİ started monitoring of shallow groundwater level (monthly) and salinity (once a year) very intensively over entire irrigated area. During this past 25 years, great change occurred in cropping pattern and water management. Yet their influences on water budget with high resolution is only visible through analysis of shallow groundwater fluctuation and groundwater salinity because actual water flow was only measured at main canal level and drainage flow was never measured in the past. Therefore we compared groundwater levels and salinity at decadal intervals to find out long term trend of high groundwater problem and salinity.

2. Material and method

We used archive data kept by DSİ. The depths of shallow groundwater observation wells were down to 4m from soil surface. Total number of observation wells was 626 in the 1980's, and in the 1990's the number was increased to 1,134, covering nearly entire command area of irrigated area. The data of three different years with 10 years' intervals (1983, 1993, and 2003) were chosen for analysis. The wells which became immeasurable due to fall of groundwater level beyond limit or by destruction were eliminated from analysis.

3. Results and discussion

3.1 Irrigation water use

The gross irrigation depth of the LSIP (irrigation intake at the Seyhan Regulator divided by the total irrigated area) exceeded 1000 mm. When comparing years before 1992 and after, irrigation increased significantly during peak season (June-August.) This was attributed to a) shift to more water consuming crops, b) transfer of water management body from government to end-users and c) increase of leakage from canals with degradation.

3.2 Shallow groundwater fluctuations

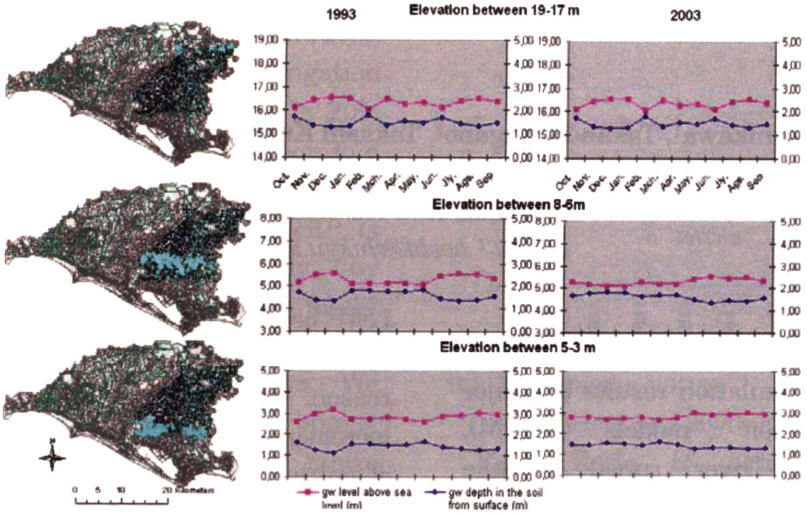

Fig.1Monthly fluctuations of the groundwater level and depth

Figure 1 compares average groundwater depth and level fluctuation of wells situated in upper, middle and lower reach of the plain in the year 1993 and 2003. The average groundwater depth fluctuated between 1m and 2m, which is relatively close to root, and the fluctuation pattern did not change over years, suggesting that drainage canal networks functioning well.

3.3 Groundwater salinity distributions

Figures 2 shows contour maps of groundwater salinity over two decades. Salinity is usually measured during peak irrigation season (July) and though there may be dilution effect of increased irrigation application, it is quite definite that groundwater salinity is decreasing consistently over the years.

4. Concluding remarks

While many parts of the world suffer from increasing salinity problems associated with over-irrigation, Lower Seyhan Plain seems to be a fortunate success case because i) introduction of summer irrigation to winter rainfall Mediterranean Climate kept soil water flux always downward, ii) good drainage networks quickly carry away surplus water and iii) irrigation water supplied from upstream has low salt content and there is no hazard for secondary salinization. This result suggests that farmers in this area should keep on using river water instead shifting to groundwater use.

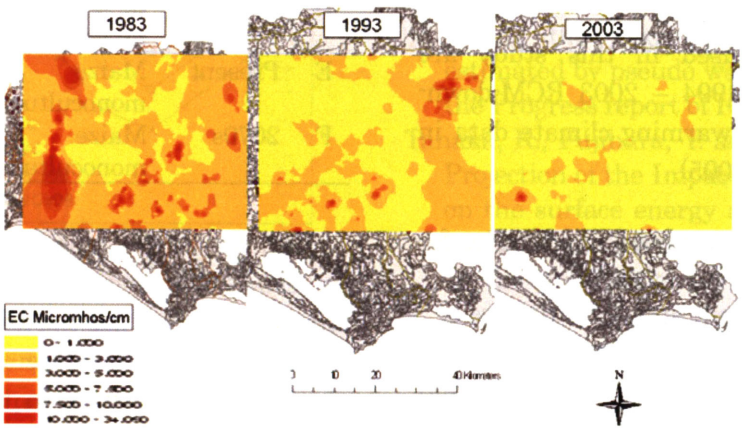

Fig.2 Change in groundwater salinity on the left bank of the LSIP.