トルコ・セイハン河下流灌漑プロジェクトにおける三次水路の灌漑効率
Water Use Efficiency of the Selected Tertiary Canals in the Lower Seyahan Irrigation Project Area, Turkey

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1. Introduction

Many large-scale irrigation projects in the arid and semi-arid regions are now facing structural changes. Water management responsibilities are being transferred from governments to end-users; water distribution management of gravity irrigation networks, designed for mono-cropping system, is becoming more complicated by diversifying cropping patterns; and predicted climate change may further bring constraints on water resource availability and management options. Therefore an assessment of the existing irrigation systems' capacity is important if existing irrigation systems were to adapt to social and climatic changes.

Lower Seyhan Irrigation Project (LSIP) is one of the largest irrigation project in Turkey which extends on the delta plain of Seyhan river basin with a total irrigable area of 133,000 ha (**Fig.1**). With the water supply from the big reservoirs in the upper stream, gravity irrigation is conducted with water efficiency lower than 50%. However, climate change experiments predict a decrease of precipitation in the upper basin. The plain has potential drainage and salinity problems, which may deteriorate either with saltwater intrusion caused by sea level rise, or with a change of water use in the district.

We started monitoring actual water use at tertiary canal level in 2004. There were several objectives as stated below. a) To assess the cause of low irrigation efficiency, b) to learn how irrigation distribution technicians allocate water, c) to have reference water budget for constructing the water balance model for the LSIP and d) to find relation between irrigation, drainage and fluctuation of shallow groundwater.

2. Material and Method

2.1 Monitoring canals

We have chosen two tertiary canals from left and right bank of Seyhan river which had representative canal type, soil and cropping pattern of the LSIP (**Fig.1**). YS7-1-1 (command area: 80.6ha) on the left bank is 'kanalet' (above-ground) type canal and farmers use siphons for letting water into the field. Citrus trees and maize were mainly cultivated in the command area. TS3 Y4-1(command area: 109.2ha) is a concrete lined canal on the right bank. The canal was built in 1974 and concrete lining is severely degraded. In 2004, egg plant and maize production was dominant in the area.

2.2 Method of monitoring

2.2.1 Water intake, tail water and drainage

Pressure water level sensors with data loggers (DL-N64, STS, Switzerland) were installed at the intakes, at the end of the tertiary canals, and on drainage canals. The difference between intake and tailwater was assumed to be sum of water intakes into fields and leakage from the canal.

2.2.2 Shallow groundwater fluctuation

We used monthly data of groundwater level in the surroundings of monitoring sites for assessing fluctuation of shallow groundwater.

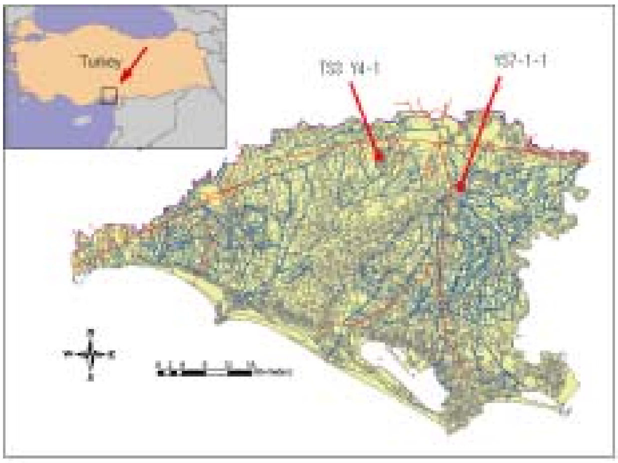

Fig. 1 Project area of the LSIP and situation of monitoring canals

3. Results and discussion

3.1 Farmers' behavior in irrigation

Water allocation within the tertiary canal was conducted on acquaintance base between farmers and they used mobile phones to communicate each other. Farmers did not respect timing of irrigation, claimed in their water demand form, but made their decisions in more opportunistic

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Table 1 Monthly water budget of YS 7-1-1

	Intake (mm)	Tail water (mm)	Drainage (mm)	Water use (mm)	Loss rate
May	456	213	221	243	0.47
June	550	202	207	348	0.37
July	641	176	186	466	0.27
Aug	524	-	204	-	-
Sept	331	-	163	-	-
Total	**2,502**	**-**	**981**	**-**	-

*Missing values are due to failure in measurement

Table 2 Monthly water budget of TS3 Y4-1

	Intake (mm)	Tail water (mm)	Drainage (mm)	Water use (mm)	Loss rate
May	270	39	90	231	0.14
June	563	21	176	543	0.04
July	666	17	146	650	0.02
Aug	394	22	75	372	0.06
Sept	225	22	76	203	0.10
Total	**2,119**	**120**	**562**	**1,999**	-

ways. Also, there was a difference in working time of distribution technitians and farmers. Farmers prefered to take water from early morning and continued till after dark. Intake gates were not well controlled by distribution technitians and often resulted in much loss as tail water.

3.2 Monthly water uses of whole command area of the canals

Table 1 and **2** are calculated results of gross monthly water budget in YS7-1-1and TS3 Y4-1. "Water use" in the tables is calculated as difference between intake and tail water and it includes leakage amount from the canals. "Loss rate" is tail water divided by intake. Surprisingly, gross intakes from May to September alone accounted to more than 2,000mm in both canals. In YS4-1-1, loss rate was remarkably high in the beginning of the season and decreased gradually towards peak irrigation season. In TS3 Y4-1, loss rate was much lower, however this was attributed to high leakage rate from the canal. Leakage rate from canals were estimated to be 36% and 44% of intake for YS7-1-1 and TS3 Y4-1, respectively. These loss rate were very high for concrete lined canals, due to lack of maintainance. Drainage flows were significantly different between two area. They both had decreasing trend toward summer.

3.3 Shallow groundwater fluctuation

Figure 2 shows changes in average level of six shallow groundwater observation wells surrounding YS7-1-1. Groundwater level was highest in December to January of winter rain period. During irrigation period, the level rose but not to great extent.

4. Concluding remarks

High transport loss of degraded canals seemed to be the primary reason of low irrigation efficiency of the LSIP. Up to present, farmers in the LSIP have free access to abundant water resource and their management is not focused on water-saving either. However irrigation inake is already at full capacity in peak season and rehabilitation is necessary to adapt to possible increase in water demand, caused by diversified cropping pattern or possible climate change. Groundwater rise during irrigation period was not a severe constraint on water management in the monitored area.

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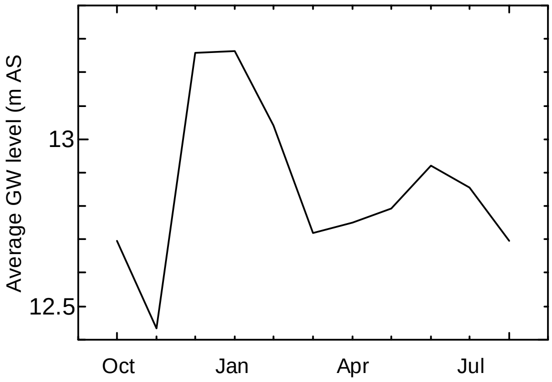

Fig. 2 Average GW level (ASL) of 6 shallow wells around YS7-1-1.