Water Use Efficiency of the Selected Tertiary Canals in the Lower Seyahan Irrigation Project Area

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1. Introduction

The primary work that the ICCAP irrigation sub-group has to carry out is to quantify water budget in the Lower Seyhan Plain, before constructing the hydrological model and predicting changes in future. However actual water budget of the project area was never measured extensively in the past.

All Water Users Associations (WUAs) use "DSI Sulamalarinda Bitki su Tutimleri ve Sulama Suyu Ihtiyaclar (1988)" for calculation of their irrigation water demands. Crop water demand multiplied by cultivation area is added to calcultate total water demand at main canal inlet. They strictly monitor water intake from the main conveyance canal to ensure their irrigation water demand. After the intake, water allocation within the WUA is controlled by water distribution technicians and there is no monitoring or measurement record.

In the last report (Nagano and Donma, 2004) we pointed out that gross irrigation depth of the LSIP (irrigation intake at Seyhan Regulator divided by total irrigated area) was exceeding 1000mm and irrigation efficiency was below 50%. Also there seemed an incresing trend in gross irrigation depth in recent years. There are many possible causes e.g. a) leakage from canals, b) bad design of canals which result in much loss of tail water, c) diversified cropping pattern, d) inexperience of irrigation technicians, e) over-use of water in the farmland, etc..

Therefore we decided to actually monitor water use at tertiary canal level. There were several objectives for this monitoring as stated below.

a) To assess the cause of low irrigation efficiency, b) to learn how irrigation distribution technicians allocate water, c) to quantify actual water intake to farmland of different crops, d) to have reference water budget for constructing the water balance model for the LSIP and e) to find relation between irrigation, drainage and fluctuation of shallow groundwater.

2. Material and Method

2.1 Monitoring canals

There were several conditions for determining monitoring canals. First of all, canal type, soil of the command area, plot size distribution and cropping pattern had to be representative of the LSIP. Area with conjunctive use of groundwater or reuse of drainage water had to be avoided to simplify water budget quantification. We also needed assistance by WUAs for installation and protection of measurement devices, collection of information, and for persuading farmers to collaborate with us.

Finally we decided to monitor two tertiary canals, one each from left and right bank of Seyhan River.

2.1.1 YS7-1-1 in Gazi WUA

YS7-1-1 belongs to Gazi WUA in the left bank of Seyhan River. It is a 'kanalet' type and farmers use siphons for letting water into the field. There is one diversion on the canal, operated exclusively for carrying water to number of farm plots. Citrus trees and maize are mainly cultivated in the command area. Tail water from the canal flows into YD4. Entire command area of YS7-1-1 is not equipped with subsurface drainage.

2.1.2 TS3 Y4-1 in Yesilova WUA

TS3 Y4-1 is a concrete lined canal which belongs to Yesilova WUA on the right bank of Seyhan River. Main crops of canal's command area is maize and water melon. It has total length of 3,750m and command area of 300ha.

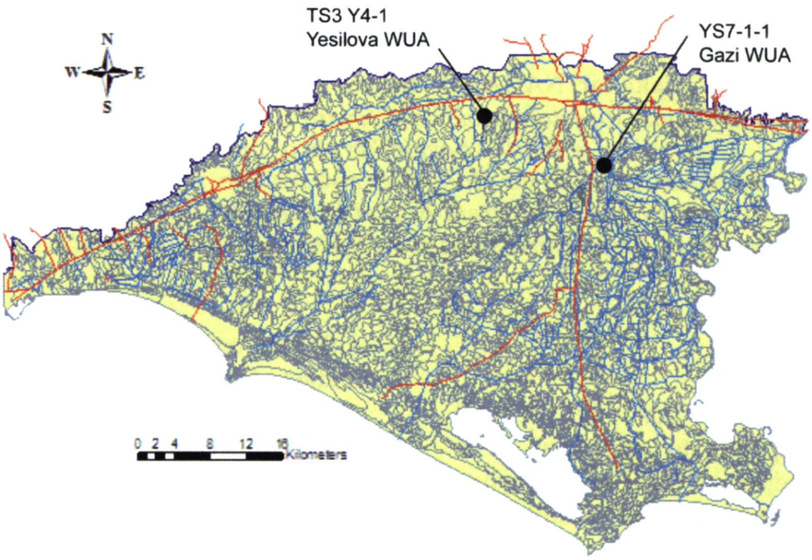


Fig. 1 Situation of selected tertiary canals in the LSIP.

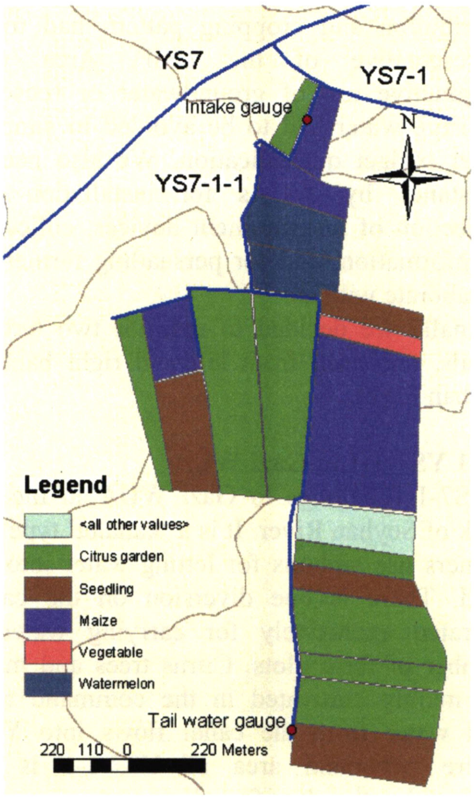


Fig. 2 Land use in command area of YS7-1-1.

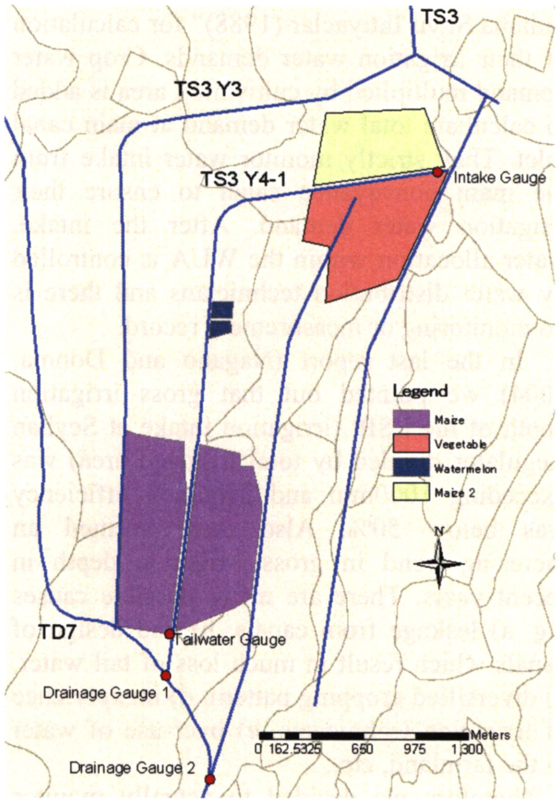
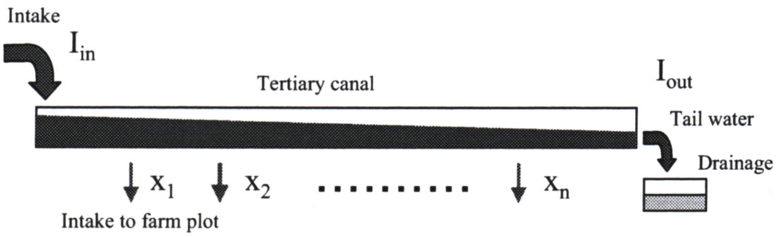


Fig. 3 Land use in command area of TS3 Y4-1.

The canal was built in 1974 and concrete lining is severely degraded. The command area of TS3 Y4-1 is all equipped with subsurface drainage. There are intake gates to farm plots but majority of them are broken after 30 years and farmers use sand bags for controlling intakes. Plot sizes are relatively big. In 2004, egg plant and maize production was dominant in the area. Many field plots used groundwater and only a few was using canal water.

2.2 Method of monitoring



$$I_{in} - I_{out} = \sum_{1}^{n} x_i + leakage$$

n: number of farm plots

Fig. 4 Basic idea of measurement.

2.2.1 Water intake and tail water

Pressure water level sensors with data loggers (DL-N64, STS, Switzerland) were installed at the intakes and at the end of the tertiary canals. According to dimensions of canals, calibration were made to relate water level to flow volume. Water level was measured every 1 minute and stored as average of every 10 minutes.

2.2.2. Calculation of water use

Figure 4 illustrates basic idea of water budget calculation. The difference between continuous measurement of intake and tailwater is assumed to be sum of water intakes into fields and leakage from the canal. We were to identify irrigated fields at a specific day from water demand tickets kept by irrigation distribution technitians. Direct measurement of intakes into each farm plot was carried out by Dr. Önder (please see his report.)

2.2.3 Soil moisture monitoring

We have chosen monitoring farm plots of representative land use in the command area of each canal and tried to measure soil moisture evolution using Soil Profile Probe (Delta device PR-1, Great Britain) which employs ADR method. However due to failure of the device, measurements were only taken in a limited number of plots in the early season.

2.2.4 Shallow groundwater fluctuation

We used monthly data of groundwater level and salinity collected by DSI in the surroundings of monitoring sites for assessing fluctuation of shallow groundwater.

3. Results and discussion

3.1 Farmers' behavior in irrigation

During the course of measurement, we found out that farmers' irrigation practice was somewhat different from principle rule.

a) Water allocation within the tertiary canal is conducted on acquaintance base between farmers and they use cellular phones to communicate each other. Therefore farmers' conducts are more opport
b) unisitc and they do not respect timing of irrigation claimed in water demand ticket. Water demand tickets are not used for planning allocation of water, but as a proof or reciept, filled by technitians, checking irrigtaion going on site.
c) There is a differnce in working time of distribution technitians and farmers. Farmers prefer to take water from early morning and continue till after dark. Therefore distribution techinitians are usually informed after the operation.

3.2 Fluctuation of Water use

Figure 5 shows an example of intake and tailwater fluctuation in YS7-1-1 in Gazi WUA. The arrowed lines in the figure show irrigation periods recorded in water demand tickets. It is difficult to determine irrigation time because there are a lot of fluctuations in water use and

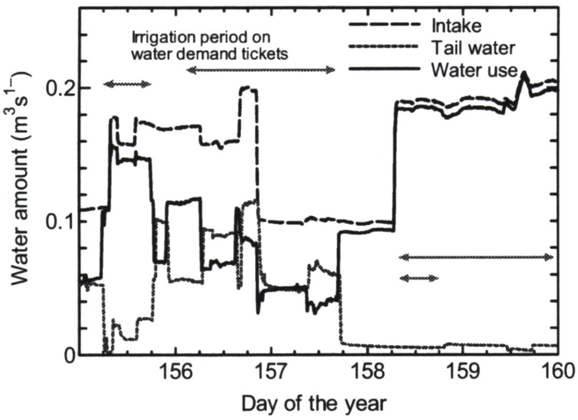


Fig. 5 Example of water use in YS7-1-1.

Table 1 Monthly water use in YS 7-1-1.

	Intake		Tail water	Water use		Tail loss rate
	m3	mm	m3	m3	mm	
May	367,733	456	171,866	195,867	243	0.47
June	442,964	550	162,534	280,431	348	0.37
July	462,514	574	122,036	340,478	422	0.26
Aug	422,220	524				
Sep	267,096	331				
Total	1,962,528	2,435				

Table 2 Monthly water use in TS3 Y4-1.

	Water intake		Tail loss	Water use		Loss rate
	m3	mm	m3	m3	mm	
May	295,211	270				
June	615,284	563	49,725	565,559	518	0.08
July	727,712	666	44,265	683,446	626	0.06
Aug	430,623	394	50,642	379,982	348	0.12
Sep	245,397	225	48,531	196,865	180	0.20
Total	2,314,226	2,119	193,163	1,825,852		

they do not coincide with recorded period. We need furthur analysis to find tendencies in water management and to quantify water use of each farm plot.

3.3 Monthly water uses of whole command area of the canals

Table 1 and 2 are calculated results of gross monthly intake and tail water 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 loss divided by intake. Surprisingly, gross intakes from May to September alone accounted to 2000mm or more 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 may be attributed to high leakage loss from the canal. Very large amount of water use also confirms it.

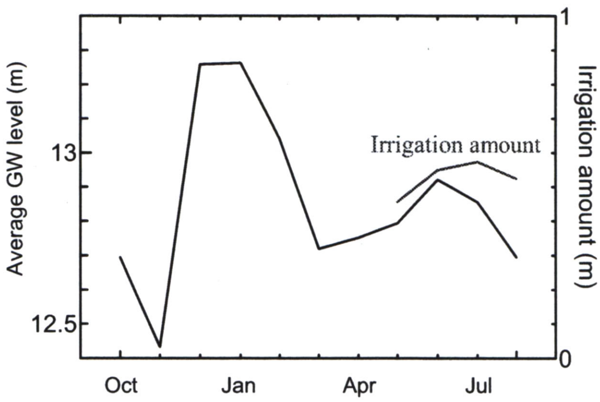


Fig. 6 Average GW level (ASL) of 6 shallow wells around YS7-1-1.

These results suggest that farmers have abundant water in the canals and they are not consious on water savings at present.

3.4 Shallow groundwater fluctuation

Figure 6 shows changes in average level of six shallow groundwater observation wells surrounding YS7-1-1. Groundwater level was highest during December-January period. During irrigation period, the level rose but not to great extent.

4. Conclusion

- Two tertiary canals were chosen for monitoring of water budget in 2004.
- Although detailed analysis is not yet conducted, both canals take neary and over 2000mm of irrigation water.
- Tail water loss was high in Kanalet system.
- Low tail water loss in concrete lined canal was probably attributed to higher leakage from the canal.
- Groundwater fluctuation had two peaks and one of which was caused by irrigation.
- Detailed analysis of leakage, water use of different crops will be carried out in future.

References

T. Nagano and S. Donma (2004): Cropping pattern and water use in Lower Seyhan Irrigation Project. The interim report of ICCAP, 93-96.