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Environmental risk assessment

INVESTIGATION OF EFFECT OF DROUGHT IN DAMS OF THRACE REGION

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Abstract. Global warming in last years has influenced negatively on snowing in winter in Thrace region. For this reason, water levels existing its normal level in Suloglu dam in Edirne, Kirklareli and Kayali dams in Kirklareli has fall down in great amount. Decrease of water level in dams has also influenced drinking water and irrigation. It is necessary to have measured values from dams to have certain knowledge about the amount of consumed water due to drought, drinking water and irrigation. Construction and duty of other following measurement and maintenance are carried out by Head of State Water Works (DSI) in Turkey. In this work, consumption of water due to vapouring, drinking water and irrigation between 1999 and September 2001 with daily and monthly measured mean data from dams and amount of water not existing in the dams due to drought have been investigated by drawn graphs.

Keywords: drought effect, dams, Thrace region, environmental risk assessment.

AIMS AND BACKGROUND

Global warming in recent years has also affected the Trace region. A decrease in precipitation (especially snow) is the principal cause of the reduction in surface and underground water supply. A significant drop in snow fall in the region has caused the level and volume of water in dams to decrease.

There are several dams in the region, constructed and run by the state water affairs (DSI) organization. Some of the important ones are Suloglu dam in Edirne, Kirklareli and Kayali dams in Kirklareli. These dams supply water for house hold use (drinkable water) and irrigation in the area.

In this paper, results of observations made in Suloglu, Kirklareli and Kayali dams from 1999 to September 2001 are evaluated and presented. Change level and volume of water and monthly water use over time were determined, plotted and discussed.

EXPERIMENTAL

Change in the level and volume of water over time based on monthly mean and daily values. Data for the three dams were obtained from the records of DSI. Changes in the level and volume of water in the dams were determined from

these data and are shown in Figs 1-6 for each dam. To determine the daily changes in level and volume of water in dams, quadratic mean error of monthly values was calculated. What is generally called standard error in mathematics is defined as quadratic mean error in geodesy. Monthly values calculated for each dam are given in Tables 1 and 2.

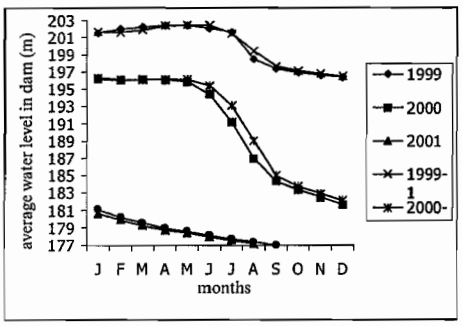

Fig. 1. Changes of the water level in Suloglu dam according to months of years

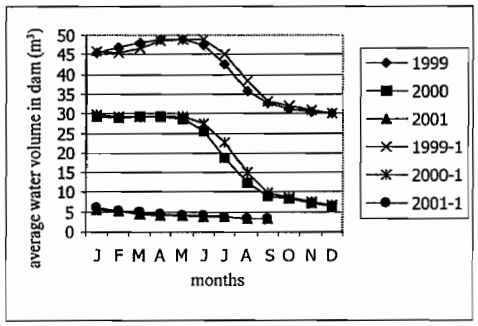

Fig. 2. Changes of the water volume in Suloglu dam according to months of years

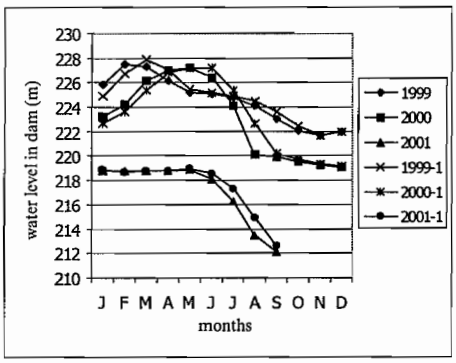

Fig. 3. Changes of the water level in Kirklareli dam according to months of years

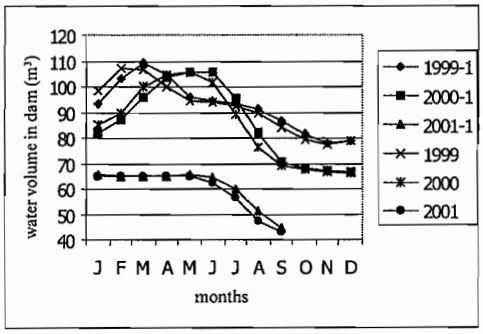

Fig. 4. Changes of the water volume in Kirklareli dam according to months of years

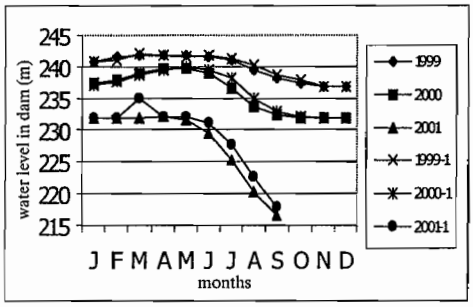

Fig. 5. Changes of the water level in Kayali dam according to months of years

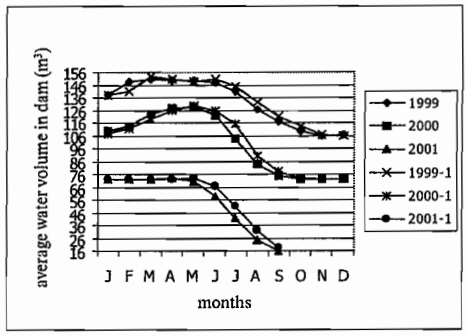

Fig. 6. Changes of the water volume in Kayali dam according to months of years

Table 1. The quadratic mean errors of changes in the level of water (m) in the dams per months of years

Dam	Year	Months											
		J	F	M	A	M	J	J	A	S	O	N	D
Suloglu	1999	0.117	0.360	0.204	0.061	0.063	0.334	0.589	0.558	0.147	0.097	0.090	0.066
	2000	0.060	0.043	0.020	0.039	0.201	0.685	1.241	1.222	0.418	0.241	0.248	0.293
	2001	0.255	0.174	0.178	0.103	0.119	0.128	0.101	0.147	0.181			
Kirklareli	1999	0.316	0.520	0.222	0.589	0.132	0.095	0.115	0.306	0.369	0.218	0.115	0.164
	2000	0.229	0.600	0.424	0.116	0.043	0.600	0.813	0.691	0.155	0.108	0.075	0.090
	2001	0.045	0.008	0.008	0.058	0.087	0.349	0.691	0.648	0.233			
Kayali	1999	0.081	0.480	0.102	0.058	0.070	0.128	0.398	0.491	0.270	0.236	0.060	0.042
	2000	0.090	0.318	0.263	0.110	0.160	0.376	0.857	0.612	0.262	0.062	0.000	0.000
	2001	0.002	0.001	0.010	0.022	0.300	1.060	1.434	1.488	0.637			

Table 2. The quadratic mean errors of changing in the volume of water (m^3) in the dams per months of years

Dam	Year	Months											
		J	F	M	A	M	J	J	A	S	O	N	D
Suloglu	1999	0.416	1.362	0.761	0.230	0.239	1.231	1.947	1.626	0.399	0.254	0.230	0.168
	2000	0.151	0.107	0.049	0.097	0.492	1.516	2.230	1.629	0.452	0.240	0.231	0.252
	2001	0.200	0.127	0.122	0.068	0.075	0.078	0.059	0.082	0.059			
Kirklareli	1999	1.753	2.874	1.212	3.195	0.716	0.504	0.564	1.494	1.805	1.023	0.562	0.801
	2000	1.117	2.976	2.302	0.632	0.236	3.260	3.999	3.379	0.621	0.381	0.263	0.319
	2001	0.159	0.284	0.282	0.201	0.296	1.225	2.323	1.948	0.701			
Kayali	1999	0.849	4.993	1.072	0.609	0.766	1.335	4.173	4.019	2.193	1.880	0.468	0.338
	2000	0.760	2.538	2.114	0.879	1.322	3.000	7.042	3.582	1.562	0.373	0.000	0.000
	2001	0.002	0.023	0.592	0.133	1.860	4.948	5.454	4.138	1.334			

Changes in water used domestically and lost through evaporation over time. Of the dams in the region, Suloglu and Kirklareli dams are utilised for household use and irrigation purpose, but Kayali dam is used only for irrigation purposes. Figures 7-12 show the changes in water used in households and irrigation, and lost through evaporation over time for the Suloglu and Kirklareli dams.

Figures 13 and 14 show the changes in water used in irrigation and lost through evaporation over time for the Kayali dam.

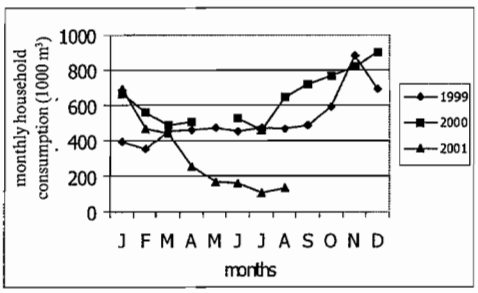

Fig. 7. Changes of the water ussed in household in Suloglu dam according to month of years

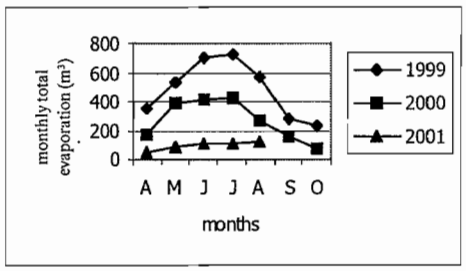

Fig. 8. Changes of the water lost through evaporation in Suloglu dam according to months of years

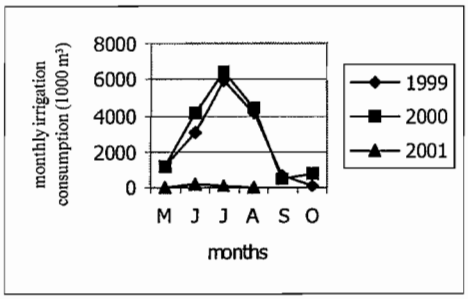

Fig. 9. Changes of the water used for irrigation in Suloglu dam according to months of years

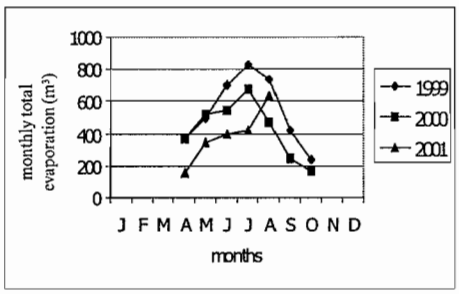

Fig. 10. Changing of the water lost through evaporation in Kirklareli dam according to months of years

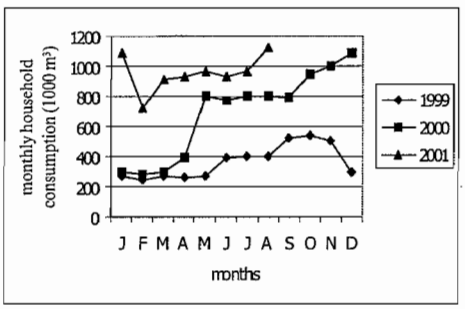

Fig. 11. Changes of the water used in household in Kirklareli dam according to months of years

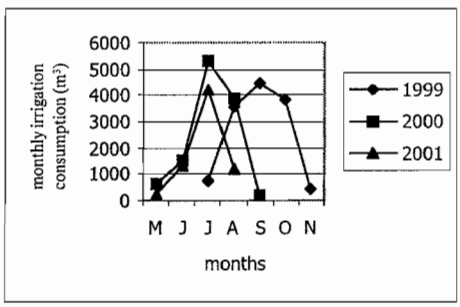

Fig. 12. Changes of the water used for irrigation in Kirklareli dam according to months of years

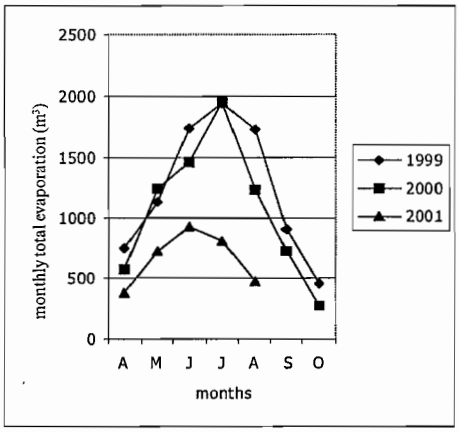

Fig. 13. Changes of the water loss throug evaporation in Kayali dam acording to months of year

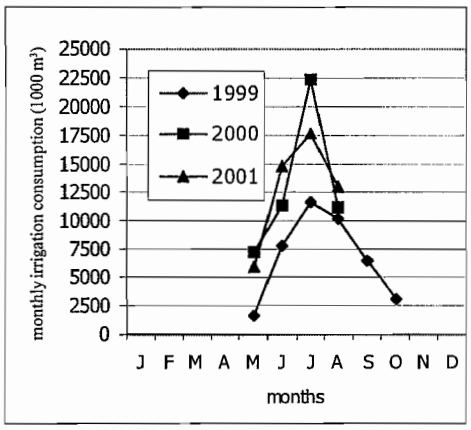

Fig. 14. Changes of the water used for irrigation in Kayali dam according to months of years

RESULTS AND DISCUSSION

Generally, there is a functional relationship between the volume of water collected in a dams, depth of water (H_i) and the area covered by the water's surface (S_I). This relationship is generated from information obtained from the area in question during the initial phase of the projects. In practice, this relationship, also known as volume/surface diagram, is given below as an example (Fig. 15). As is seen, the volume and surface of water increase with depth of water.

Water loss through evaporation is directly proportional to surface area of water. As the level (depth) of water increases, surface area increases, causing an increase in water loss through evaporation. Evaporation in the dams in the region takes place from May through September, with the highest values being in June to August (Figs 7, 10 and 13).

Water release for irrigation takes place from May trough September (Figs 9, 12 and 14). Exploration is given below for each dam.

Water loss through household use and evaporation is far less than that released for irrigation.

Suloglu dam (*Figs 1 and 2*). The volume and the mean level of water were 48.761×10^6 m^3 and 202.43 m, respectively in May 1999, and the same values were 29.900×10^6 m^3 and 196.36 m, respectively, at the end of 1999. Due to a drought, there was no change in the level of water until May 2000. In May 2000, the volume and mean level of water were 28.671×10^6 m^3, and 195.862 m, but, as can be seen in Fig. 9, due to the release of water from May to October for irrigation water level and volume decreased to 181.66 m and 6.528×10^6 m^3, respectively.

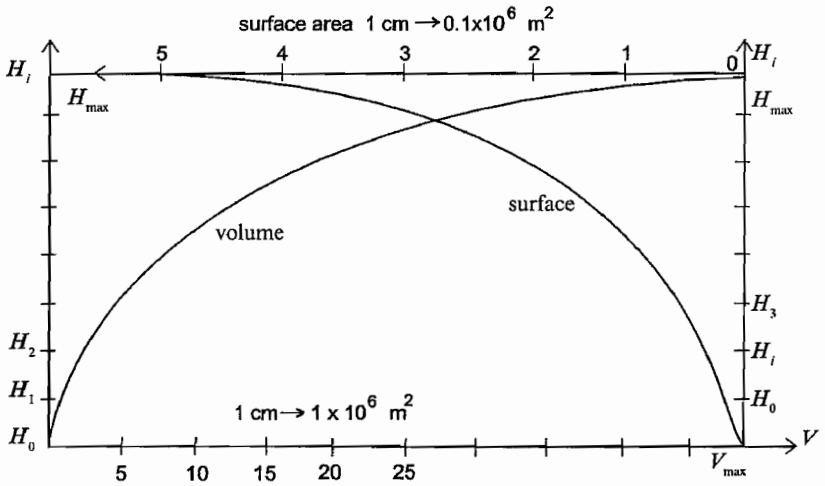

Fig. 15. A volume/surface diagram for a dam

Between May 1999 and December 2000, the differences between water levels and volumes were 20 m and 42×10^6 m^3, respectively. There was a decrease in the volume and level of water until August 2001. The level of water and volume decrease to 174.18 m and 3.222×10^6 m^3, respectively, in September 2001.

Evaporation was at its maximum in June and July in 1999 and 2000. Evaporation decreased in 2001 proportional to the decrease in water surface area resulted by the decrease in the level and volume of water in the preceding years.

Kirklareli Dam (*Figs 3 and 4*). The level and volume of water increased until February 1999, with maximum values being 241.67 m and 107.136×10^6 m^3, respectively. Starting from May, due to water release for irrigation and household use and drought, water level and volume decreased to 221.68 m and 66.638×10^6 m^3, respectively, in November. In 2000, due to precipitation water level and volume increased from 223.24 m to 227.205 m and from 85.140×10^6 m^3 to 105.734×10^6 m^3, respectively, until May. Then water level and volume decreased gradually until November (Fig. 12). The decrease was a result of water release for irrigation. In 2001, there was no noticeable change until May, but staring with May both water level and volume decreased gradually. Between the values of May 1999 and September 2001, differences were –115 m and -360×10^6 m^3, for water level and volume, respectively. Change over time for the values of the first day of each month and those of monthly averages were parallel to each other. Differences were from 0.5 to 2.5 m in water levels, and 0.375×10^6 to 0.5×10^6 m^3 in volumes from May to September.

Kayali dam (*Figs 5 and 6*). In 1999, water level and volume were somewhat increased until March. Water level and volume increased from 240.73 m and

138.08×10^6 m^3 to 241.93 m and 150.547×10^6 m^3, respectively. From March to November, water level and volume decreased on average to 236.85 m and 105.243×10^6 m^3, respectively, due to water release for irrigation. In 2000, water level and volume increased to 238.78 m and 128.663×10^6 m^3, respectively, until May due to precipitation. Then, due to water release for irrigation, water level and volume decreased to 231.94 m and 72.259×10^6 m^3, respectively, in November. There was no change until April due to a drought in the region. With the start of water release in May, water level and volume were down to 216.65 m and 16.455×10^6 m^3, respectively, in September. Differences in the April 1999 and September 2001 values of water levels and volumes were 25 m and 135×10^6 m^3, for the same period.

CONCLUSIONS

Results indicated that there were a slight increases in the water levels and volumes in Kirklareli and Kayali dams from January to April in 1999 and 2000. However, there was no change for Suloglu dam for the same period. In 2001, water levels and volumes did not change significantly in Kirklareli dams from January to April. But, due to a drought, there was a decrease in water level and volume in Suloglu dam for the same period. The highest decrease in water levels and volumes takes place when water is released for irrigation from May to October. Differences in the values of water levels between January 1999 and September 2001 for Kirklareli, Kayali and Suloglu dams are 13.76 m and 55.412×10^6 m^3, 14.08 and 121.625×10^6 m^3 and 27.34 m and 42.189×10^6 m^3, respectively.

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