3.5. Actual site water-salt balances under drainage water use for irrigation

Actual water-salt balances analysis shows, that water supply plays a basic role in its positive part, which fluctuated from 4800 to 12500 m^3/ha for cotton and up to 20600 m^3/ha/ year for rice. Precipitation value is from 1200 to 1700 m^3/ha (excluding Kyrgyzstan, where precipitation is 3200m^3/ha) and it does not play significant role in soils water-salt regime formation.

Table 3.7

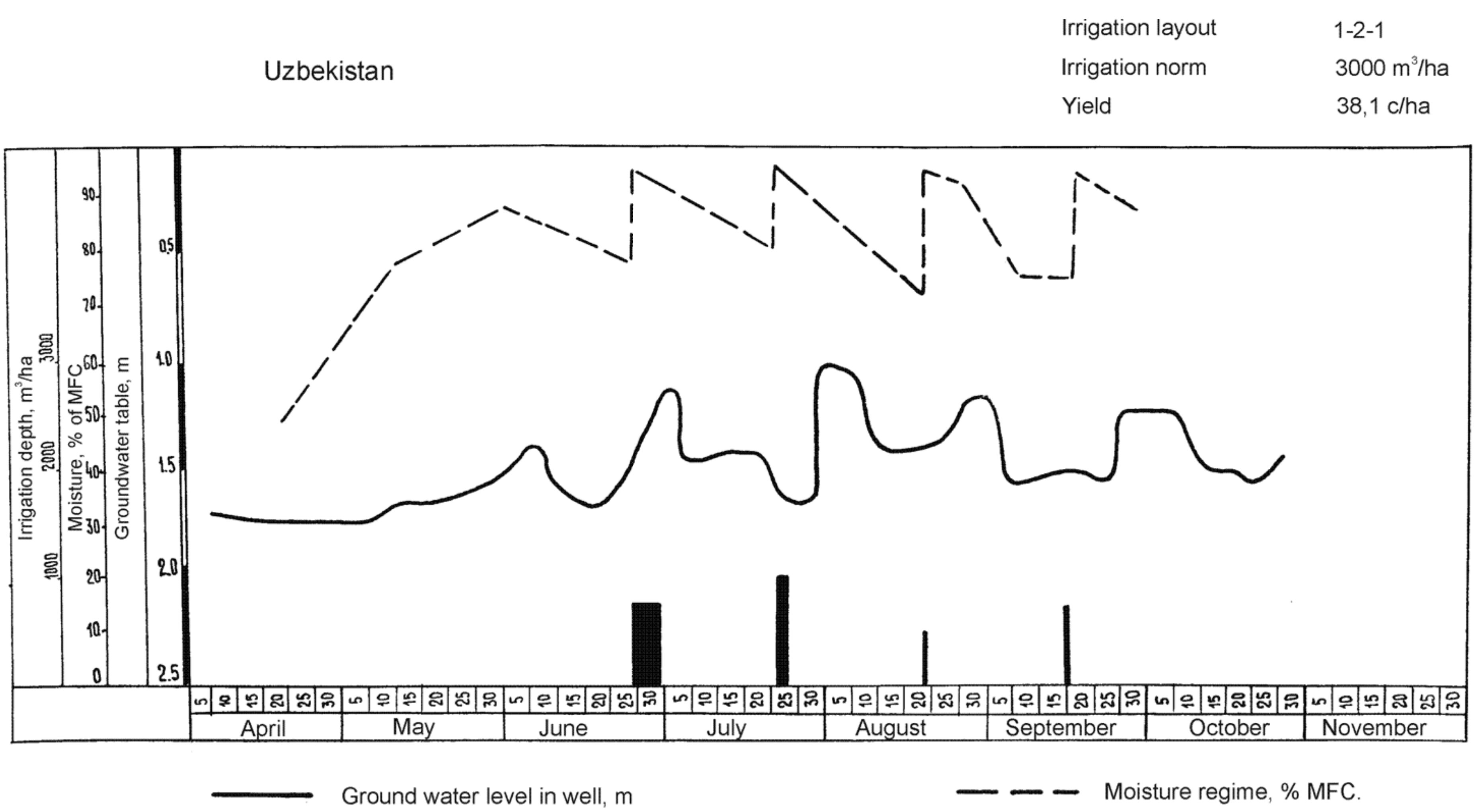
Actual water-salt balance under drainage water in-contour utilization

Direction and theme code	Inflow per year m^3/ha				Total	Discharge per year m^3/ha			Total	Balance element ratio		Annual water exchange between unsaturated zone and ground-water ± m^3/ha	Soil mois-ture, % of MFC 0-1m	Salt in-flux, t/ha	Salt removal t/ha	Salt balance t/ha, (±))
	O_c	B	Ф	П		ET	Др	O		$\frac{B+O_c}{ET}$	$\frac{Др}{B+O_c}$					
Uzbekistan																
03.1.Uz.	-	8680	-	-	8680	-	-	-	-	-	-	-	0,75 MFC	16	16	0
03.2.Uz.	-	7300	-	-	-	-	-	-	-	-	-	-	0,75 MFC	-	-	-
03.3.Uz.	1500	9220 annu-al	-	-	10720	8800	5400	-	14200	1,21	0,50	-1990	0,65-0,75 MFC	17,3	27,0	-9,7
03.4.Uz.	1360	8841	410	-	11896	8598	5800	-	14398	1,18	0,48	-3298	0,75-0,80 MFC	10,2	15,9	-5,7
03.5.Uz.	1584	12499	-	2874	16962	9087	4952	3190	17229	1.2	0,35	-2530	0,70-0,80 MFC	43,5	49,4	-5,9
03.6.Uz.	collector Shuruzyak water biological treatment												-	-	-	-
03.7.Uz.	-	10090	-	-	10900	8100	1500	-	9600	1,25	0,25	-1990	0,7-0,8 MFC	Mop =2		

Direction and theme code	Inflow per year m^3/ha				Total	Discharge per year m^3/ha			Total	Balance element ratio		Annual water exchange between unsaturated zone and ground-water ± m^3/ha	Soil mois-ture, % of MFC 0-1m	Salt in-flux, t/ha	Salt removal t/ha	Salt balance t/ha, (±))
	O_c	В	Ф	П		ET	Др	О		$\frac{B+O_c}{ET}$	$\frac{Др}{B+O_c}$					
														g/l 13,0 Mop =3 g/l 19,5 Mop =7 g/l 45,5	20,2 20,2 20,2	-7,2 -0,7 +25,3
Turkmenistan																
03.1.Tur	1500	9750	-	-	11250	10850	-	-	-	1,04	-	-400	0,7 MFC	20,0	20,0	0
03.2.Tur	1200	8870	-	-	10070	9150	-	-	-	1,10	-	-920	0,7-0,8 MFC	22,0	22,0	0
Kazakhstan																
03.1.Kaz.	1700	7000	-	1900	10600	8400	1600	-	10000	1,04	0,22	-1600	0,7-0,75 MFC	7,3	10,3	-2,7

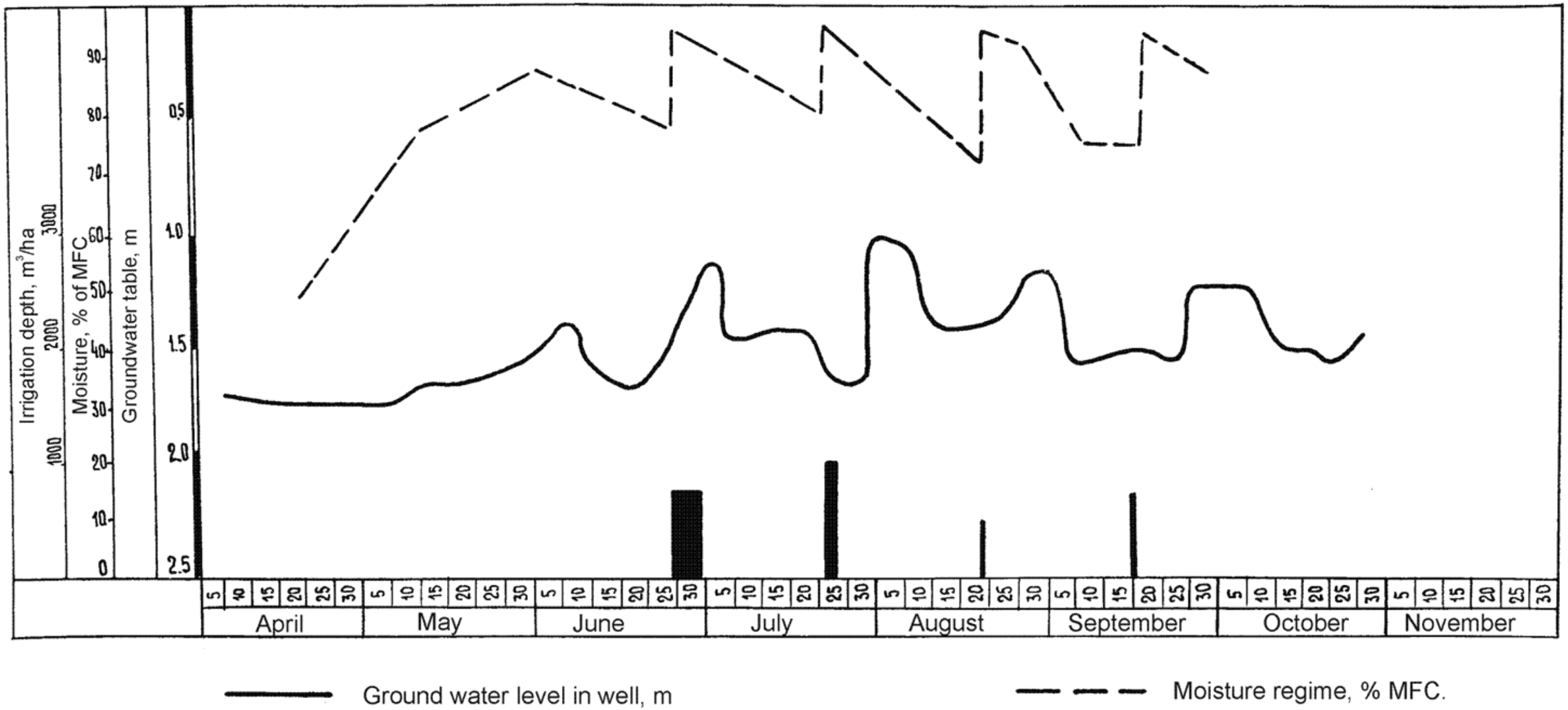
Direction and theme code	Inflow per year m^3/ha				Total	Discharge per year m^3/ha			Total	Balance element ratio		Annual water exchange between unsaturated zone and ground-water ± m^3/ha	Soil mois-ture, % of MFC 0-1m	Salt in-flux, t/ha	Salt removal t/ha	Salt balance t/ha, (±))
	O_c	B	Φ	П		ET	Др	O		(B+Oc) / ET	Др / (B+Oc)					
03.2.Kaz. rice	1600	20600	-	-	22200	6880	10800	-	17680	1,35	0,45	-1660	0,8-0,9 MFC	-	-	-
Kyrgyzstan																
03.1.Kyr lucerne and maize	3200	7100	-	-	10300	8500	2220	-	10720	1.21	0,21	-1800	MFC	6,30	3,60	+27
	3200	4800	-	-	8000	8500	1480	-	9980	0,94	0,19	+500	0,7-0,8 MFC	6,30	3,60	+27

Explanation: O_c -precipitation, B -annual water supply, Φ -losses for filtration from canals, П -ground inflow, ET -total evaporation, Др -drainage outflow, O - ground outflow .

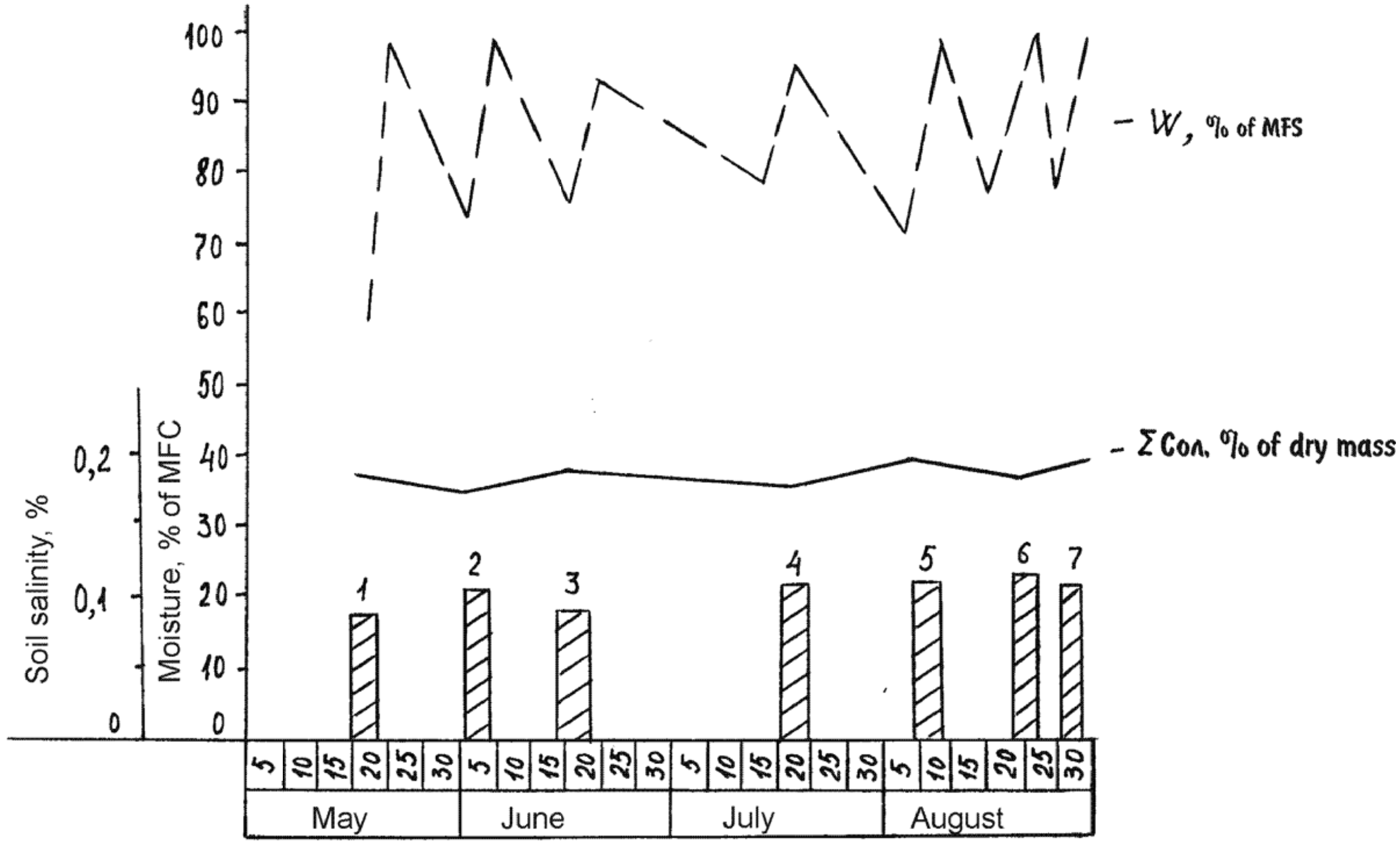


Dr. 3.1. Dynamics of soil 1 m layer moisture on 1st sub-rayon (Fergana valley).

Irrigation layout	0-2-1
Irrigation norm	2500 m^3/ha
Yield	24,2 c/ha



Dr. 3.2. Dynamics of soil 1 m layer moisture on 2[st] sub-rayon (Fergana valley).



Dr. 3.3. Average moisture and salt content within 0 - 60 cm layer in Kyrgyzstan (crop-lucerne).

— — —— Moisture regime, % of MFC ; ——— Salt regime, %

1, 2.. 7 - irrigations No.

Total evaporation (or evapotranspiration) plays a main role in the negative water-salt balance, which in arid zone conditions was 6900-10850 m^3/ha/year. Drainage outflow from irrigated lands plays secondary role and achieves from 1500 to 5800 m/ha/year for cotton and up to 10000-12000 m/ha for rice.

Water-salt balance results which were obtained during investigations are shown in table 3.7. Results showed, that actual irrigation regime of leaching type was kept, i.e water supply exceeded total evaporation.

Relation of total water supply to total evaporation ($\frac{B+A}{ET}$) fluctuated from 1,04 to 1,35 and only in one case it is lower- 1,0 (Kyrgyzstan, table 3.7).

Relation of drainage outflow to water supply fluctuated from 0,20 to 0,5.

In cotton root zone or aeration zone, in annual cycle, favorable balance was found which provides salt removal to lower layer. Water exchange value with negative sign (-g) was from 400 to 3300 m/ha.

Salt balance of irrigated site is formed in accordance with water balance. Results of calculations (table 3.7) show, that in spite of significant salts inflow (from 6 to 44 t/ha/year) with irrigation water under drainage water use, drainage capacity provides stable salt removal under leaching irrigation regime. Difference between salts influx and removal are formed with negative sign and value from 1 to 10 t/ha/year.

Positive balance with sign "+" , i.e. salt accumulation was observed in annual cycle on separate sites during vegetation, when total evaporation in summer months exceeds water supply, but the following leaching irrigations provide soil desalinization to the next season. Example of such balance where insignificant salt influx exceeds removal (0,5-2,6 t/ha) is shown in table 3.8 on the plot, which is located in Central Fergana (Uzbekistan).

Salt balance of desalinizing type in annual cycle was provided naturally under irrigation water salinity reduction to specific limit; drainage water use under concentration 7,0 g/l leads to salts accumulation up to 25 t/ha and soil salinity restoration, while under water salinity 3-4 g/l desalinizing balance is still kept.

According to results of actual and foreseen water-salt balances over the pilot plots annual cycle graph of salts stock dependence on relation between total water supply and total evaporation and drainage outflow (fig. 3.4).

Data show, that under drainage water use on irrigation with salinity from 2 to 4 g/l leaching irrigation regime should be kept, i.e. total water supply (including precipitation) in annual cycle should exceed total evaporation (or evapotranspiration). This provides salts content stabilization in calculated layer, that is important factor under brackish water reuse. For soil salt regime stabilization relation (B+A): ET not less than 1,05 should be kept, and relation of drainage outflow to water supply (Др:B) not less than 0,3-0,4.

Table 3.8

Common salt balance for pilot plot N 1, 1079 (annual) (Central Fergana)

Month	Salt influx with precipitation	Salt influx with irrigation water	Salt influx with ground water	Sum of positive elements	Salt removal with drainage outflow		salt removal with ground water	Sum of negative elements	Difference
					drainage water	return water			
I.	0,09	3,79	0,94	4,82	8,38			8,39	-3,56
II.	0,02	-	1,01	1,03	5,46			5,46	-4,43
III	0,06	-	-	0,06	2,69		0,36	3,04	-2,98
IV	0,25	-	-	0,26	1,45		0,02	1,47	-1,22
V	0,05	2,66	0,60	3,31	0,97	0,21	-	1,18	2,13
VI	0,01	3,89	0,90	4,8	2,74	0,94	-	3,68	1,12
VII	-	6,56	1,72	8,28	3,22	2,48	-	5,70	2,58
VIII	-	7,91	1,4	9,31	3,21	5,56	-	8,77	0,54
IX	0,02	2,55	-	2,57	1,75	0,55	0,49	2,79	-0,22
X	0,01	-	0,73	0,74	1,72	-	-	1,12	-0,38
XI	0,03	-	-	0,03	0,80	-	0,92	1,72	-1,69
XII	0,01	5,4	-	5,41	0,74	-	3,4	4,14	1,27
TOTAL:	0,56	32,76	7,3	40,61	32,53	9,74	5,18	47,56	-6,84