

G	Summary of research project (see instruction on page 1)
<p>1 Objective and technical fields: Development of set of measures on water use improvement and soil salinization prevention on base of land drainability increase by means of close drainage construction. Drainage efficiency and workability determination. Soil water-salt regime management.</p>	
<p>2 Scientific and technical approach: Soil salinization prevention, land and water productivity increase based on land drainability improvement and leaching regime of irrigation. Meaning: Set of measures' scientific ground on water use and soil water-salt regime management.</p>	
<p>3 Environment characteristics: Climate is sharply continental. Average annual temperature is 13-15.6 °C, in July 27 °C. Precipitation is 76-133 mm, aridity coefficient is 17-32. Evaporativity is 1000-1180 mm. Relative air humidity is 55-65 %. Relief: Slightly corrugated plain. Lithology: Loam, clay, sandy clay and sand (20 m). Separating layer thickness is 12-25 m, its permeability coefficient is 0.01-0.2 m/day. Cover loam thickness is 10-15 m; permeability coefficient is 0.9 m/day; aquifer thickness is 5-15 m, permeability coefficient is 3-5 m/day. Groundwater level is 1.0-2.5 m, water salinity is 5-50 g/l, type is from chloride-sulphate to sulphate-chloride, from sodium-magnesium to calcium. Water availability (saturation deficit) is 0.12. Artesian waters head is 0.01-0.08 m higher than groundwater level. Water salinity is 0.55-3.8 g/l. Drainage effluent salinity is 5-10 g/l. Soil contains gypsum, which content is 2-20 % (within 0-3 m layer). Soils are middle and strongly salinized (1-2.4 %).</p>	
<p>4 Parameters of Pilot Projects and Technical Solutions: Pilot site area is 97 ha (gross), 80.7 ha (net). Crop pattern: cotton 48-64 %, corn 5-14 %, vegetables and melons 8-15 %. Irrigation network - concrete flumes with efficiency 0.96-0.98. Technical state is satisfactory. Water is supplied from Big Andijan canal with salinity 0.5-0.9 g/l. Drainage network - close horizontal drains, specific extent is 40 m/ha, depth 2.5-3.0 m; open collectors depth is 3-4 m. Distance between drains is 200-250 m. Groundwater observation was performed over 8 wells; artesian water - over 8 piezometers with depth 2.5-20 m.</p>	
<p>5 Methodology: Field investigations of water, salt and water-salt balance elements movement within unsaturated zone, groundwater and irrigated area as a whole. Pilot site was equipped by means of water and salt accounting. Observations were performed for irrigation and leaching regime before and after each irrigation, water supply release; water and soil sampling was done. Multicriterial analysis was selected as a base for data processing.</p>	
<p>6 Results: Initial reclamation state of pilot site before development (1977) was as follows:</p> <ul style="list-style-type: none"> • shallow groundwater level (1-1.8 m) and artesian water head 0.01-0.08 m higher than groundwater level; • groundwater high salinity (5-38 g/l); • drainage effluent high salinity (5.5-10 g/l); • soil middle and strong salinization (1-2.4 %): strongly salinized - 45 ha, middle-salinized - 32.3 ha, slightly salinized - 10 ha; • low cotton yield (0.79 t/ha). <p>Within 1979-1986 number of waterings was 5-6 during growing season by depth 500-2000 cu.m/ha and irrigation norm 6.5-8.46 th.cu.m/ha. Irrigation interval was 10-27 days. Besides autumn leachings were performed by rate of 2-3.4 th.cu.m/ha. Soil moisture dynamics study showed that moisture before vegetation is supported within the limits of 65-73 %, during next irrigations within 76-78 %. After irrigation groundwater level increases to 1.3-1.5 m. Soil moisture achieves 100 % FFMC.</p>	

Water stock within 1 m-layer is 3.1-3.38 th.cu.m/ha. After 10-20 days level decreases and water stock is also decreases to 2.4-2.5 th.cu.m/ha.

Average weighted irrigation norm is 8.48-11.5 th.cu.m/ha per year.

Drainage outflow increased to 0.4-0.5 l/sec/ha within July-August and winter period (December-January). Average annual drainage modulus is 0.16-0.21 l/sec/ha. Relationship between water supply and drainage outflow can be described by the following equation

$$D_p^{CT} = 160.7 + 0.27 O_p.$$

Groundwater regime: There are two periods of high level position within a year: to 1.0-1.5 m during growing season (July-August) and to 1.5-2.0 m during autumn leaching. Between this periods level decreased by rate 4.6-5.2 cm/day.

Water-salt balance. During investigations period negative balance was established. Water supply plus precipitation to total evaporation ratio was 1.1-1.43.

Total evaporation prevailed among water expenses: 8920 cu.m/ha (892 mm/year). Drainage outflow was the second : 5690 cu.m/ha. Salt balance: annual salt removal from unsaturated zone was 20 t/ha (mean value for 1978-1986). Irrigation water downward flow was 2.85 th.cu.m/ha. Total salt balance shows that under salt total influx to 20-35 t/ha annual removal is 37-58 t/ha, i.e. difference between influx and removal is 17-20 t/ha.

Support of leaching regime of irrigation and negative water-salt balance promoted gradual groundwater salinity decrease. By 1986 on main part of land (58.4 %) groundwater salinity was 3-5 g/l; 5-10 g/l (17.1 %); > 10 g/l (11.6 %) average salinity decreased from 16 to 5 g/l.

Drainage effluent salinity also decreased from 5-10 to 2-4 g/l.

It is found that for salt content stability it is necessary that drainage outflow to water supply ratio should be not less than 0.35 and water supply plus precipitation to evaporation ratio should be not less than 1.05 [(B+O)/E >= 1.05].

Main result of investigations is achievement the following objectives under close horizontal drainage operation and optimal reclamation regime support:

- to decrease of leaching regime share from 1.43 to 1.05-1.0 that permitted to decrease annual water consumption rate on 10-15 %;
- to desalinate groundwater from 15 to 5 g/l in average;
- to provide soil desalinization: in 1978 almost half of land (45 ha) was strongly salinized; 32.3 ha were middle salinized and 10 ha - slightly salinized; in 1986 67.2 ha land became non-salinized, 19.2 ha - slightly salinized and only 15.4 ha - middle salinized.

Cotton yield increased from 0.7-0.9 to 2.83 t/ha.

Water productivity increased from 10 th.cu.m/t to 0.35-0.39 th.cu.m/t.

Economic efficiency was 500 rouble/ha. Zone of active close horizontal drainage influence was 100-200 m depending on drainage pipe diameter.

H	Suggested key-words		
1	Soil salinization	4	Leaching regime
2	Optimal drainability	5	Soil productivity
3	Groundwater depletion rate	6	Irrigation water saving

I	Most recent publications (maximum 3)		
1	<i>Author(s):</i> Kh.Yakubov, B.Nurtayev		
	<i>Title:</i> Drainage effluent hydrochemical regime within new irrigated land of Central Fergana and its quality forecast		
	<i>Publication details:</i> Soil water-salt regime and balance elements changes under influence of intensive close drainage and leaching regime of irrigation under conditions of hardly reclaimed gypsum-bearing soils. Drainage effluent quality forecast.		

	Year of publication: 1994	free access	<input checked="" type="checkbox"/>	restricted	<input type="checkbox"/>	confidential	<input type="checkbox"/>
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