

**REGISTER OF RESEARCH ON IRRIGATION AND DRAINAGE**

**QUESTIONNAIRE**

<b>A</b>	<b>Project title:</b> Irrigated lands water-salt regime and balance management under influence of artesian water (1960-1975).
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<b>B</b>	<b>Topic n° : 2</b>	Sub-topic n°:	2
1)	Category 02	Technical field n°:	2

<b>C</b>	<b>Project location</b> Chimkent province, Pakhtaaraal district, state farm "Pakhtaaraal"		
	Country: Republic of Kazakhstan	Area:	13.500 ha
	<b>Precise details if possible</b>		
	Country(ies):	Locality(ies):	
	City(ies):	Others(s):	

<b>D</b>	<b>Duration of the project:</b>		
	Year in which the project was started 1960	Project completed:	1990
		Expected completion date:	1970, 1980, 1985

<b>E</b>	<b>Organizations and technical staff involved</b>				
1	Supervisor/project coordinator (SURNAME, First name): Reshetkina Natalia		70%		
	Organization: VNIIGIM		Staff resources		
	Address: 44, B.Academicheskaya str. Moskow      telephone:				
	E-mail:	fax:	2)		
Other counterparts:					
	Organizations (full name or acronym)	Surname			First name
1	VNIIGIM	Spizin A.			30%
2					%
3			%		
4			%		
Other collaborators:				man-years	

<b>F</b>	<b>Funding agencies</b>	
	Full name or acronym	Percentage of project finance provided
1	Ministry for Land Reclamation and Water Management of Uzbekistan	60%
2	Ministry for Land Reclamation and Water Management of Kazakhstan	40%
3		%

<b>G</b>	<b>Summary of research project (see instruction on page 1)</b>
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### *1 Objective and technical fields:*

Soil salinization prevention on base of land drainability increase and leaching regime of irrigation.

Objectives: water use improvement and soil water-salt regime management, irrigated lands productivity increase on background of vertical drainage.

### *2 Scientific and technical approach:*

Land salinization prevention and productivity increase on base of territory drainability strengthening and salt removal by means of groundwater pumping by optimal regime, providing soil water-salt regime optimal management.

Meaning: development of set of measures on irrigated lands productivity increase and irrigation water saving.

### *3 Environment characteristics:*

Climate is continental. Average annual air temperature is 12.5-13.0<sup>0</sup>C. Frost-free period is 170-200 days. Sum of positive temperatures is 4000-4100<sup>0</sup>C. Precipitation is 250-350 mm; evaporativity is 1120-1280 mm. relative air humidity is 55-60 %, in summer 25-30 %.

Geomorphology: Sirdarya alluvial plain, slightly corrugated relief with slope of 0.0003-0.0005.

Lithology: quaternary sediments, cover loam (15-25 m; permeability  $K_p=0.1-0.15$  m/day); small and fine-grained sands (25-100 m;  $K_p= 20-30$  m/day). Loam resistance coefficient  $\Phi=150-250$  days, overflow coefficient  $B=200-250$  sq.m under its intensity  $\omega=0.02-0.3$  m/day.

Before land development groundwater level was 10-15 m, by 1958-1960 it increased to 1-1.5 m (spring) and 2.5 (autumn). Groundwater salinity varies within 5-10 g/l.

Artesian water head is 0.05-0.5 m higher of groundwater level. Underground inflow is 500-1000 cu.m/ha. Groundwater salinity is 4-5 g/l and it is suitable for irrigation by its mixing with river water as 1:2 and 1:3.

Soils: sandy loam light and middle loam. Unsaturated zone soils permeability coefficient is 0.15-0.3 m/day. Soils are desalinized to depth of 1.5-2.0 m, downward they are salinized to 0.7-1.5% (solid residue). Under irrigation salts were re-distributed, soils are salinized to 2-2.5 m. Salinization type in 1960 was chloride-sulfate.

In 1958-1962 25-33 % of irrigated lands were middle and strongly salinized. Total area subjected to salinization was 75-80 % which led to crop yield decrease to 2.4 t/ha.

### *4 Parameters of Pilot Projects and Technical Solutions:*

Irrigated area is 13.000 ha (gross); 11.5 th. ha (net). Land use efficiency is 0.85.

Water supply was performed from earthen K-20 canal and its distributors, which extent is 200 km. Head water-intake is 11-13 cu.m/sec. Canal efficiency is 0.94, system's efficiency is 0.7-0.75.

Collectors specific extent is 6-8 m/ha. There are 78 wells by depth 55-75 m with gravel-sand screens. Drilling diameter is 426 mm, screen length is 15-30 m. well discharge is 50-75 l/sec, specific yield – 4.6 l/sec/m.

### *5 Methodology:*

Field investigations of water and salt movement. Permanent balance sites by area of 100-250 ha were established where regular observations were performed on water-salt balance and regime together with irrigation. These sites were equipped by metering and measurement devices. Multicriterial analysis was used for data processing.

### *6 Results*

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State farm was established in 1926-1928 and till 1957 was one of the best in USSR. Wide-scale development of lands around state farm led to groundwater level increase and soil secondary salinization. By 1960 about 70 % irrigated lands were secondary salinized, from which 30-35 %

were subjected to middle and strong salinization. Open drains with density 12-14 m/ha construction, leaching, sprinkler-irrigation did not give positive results due to instability of drains' slopes and artesian water influence.

In 1964-1965 the first stage of vertical drainage system VDS consisting of 54 wells was put in operation and within 1968-78 wells which provides water discharge 70-90 mln.cu.m/year instead of 130 mln.cu.m planned. Within the initial period of VDS operation, when VDS was not constructed within surrounding areas, inflow from outside constituted 40-45 % of pumped water, then after VDS construction it decreased to 5-10 %.

VDS operation permitted:

- to create high territory's drainability providing groundwater overflow from cover loam to aquifer in amount of 3.5-5.0 th. cu.m./ha;
- to regulate groundwater level and piezometric head within wide limits: 1.5-1.8 (spring) to 3.5-4.0 (autumn before leching). Piezometric head was supported at 0.4-0.6 m lower of groundwater level;
- to manage groundwater depletion rate from 0.2-0.4 to 0.6-10 cm/sec;
- to manage by unsaturated zone and cover loam soils desalinization rate by creation of free volume for leaching;
- during growing period there were 3 waterings by sprinklers: by depth of 800-900 cu.m/ha (irrigation norm); 2400-2700 cu.m/ha and by irrigation in furrows it was 32000-8400 cu.m/ha.
- Soil desalinization mainly was achieved by winter-spring leaching.

On strongly salinized soils rate of leaching was 6500-7800, on middle salinized 4500-5000, on slightly salinized 2500 cu.m/ha.

Fields under perennial grasses also were washed up.

Average annual water supply was 7.2-10.8 th. cu.m./ha and together with rainfall 10.2-13.3 th. cu.m./ha.

Since 1964 till 1984 over state farm territory leaching regime of irrigation was followed  $K=(B+O_c)/(ET)=1.15-1.28$ .

This regime created high rate of desalinization: over middle and strongly salinized soils salt removal within the first years was from 20, 40-45 to 70-80 t/ha including from cover loam – 20-25 t/ha. Along with unsaturated zone desalinization its rate was slowing down;

- to create negative water-salt balance within unsaturated zone. If within 1961-1964 balance was positive with salt influx of 4.1-7.0 t/ha, within 1965-1984 it was negative with salt removal of 6.8-21.5 t/ha;
- to create regular reclamation background over state farm territory. Only 12 % of middle and strongly salinized lands remained till 1966 instead of 30-35 % in 1957. In 1972 94 % of lands were non-salinized;
- to achieve full soil desalinization within 4-5 years not only of unsaturated zone but cover loam too;
- to decrease and uniform groundwater salinity to 3.5-4.0 g/l;
- to stabilize pumped water salinity within 4.0-4.5 g/l. Salinity increase during long period did not exceed more than 0.3-0.5 g/l;
- to achieve high crop yield and stabilize it. Mean perennial (1965-1980) cotton yield growth after putting in operation VDS was 0.29 t/ha and was kept by this level to till 1976.

Economic efficiency of VDS was 280-300 rouble/ha.

Since 1980 water supply decreased 20-25 %; irrigation water salinity increased up to 1.2 g/l; drainability decreased by 2-3 times.

Since 1990 VDS does not work due to different reasons, mainly due to high prices for electricity, pumping equipment and spare parts absence, etc.

Since 1984 due to reclamation situation changes unsaturated zone and irrigated area water-salt balance became positive with salt accumulation.

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H	Suggested key-words		
1	VDS (vertical drainage system)	4	Soil reclamation regime
2	VDS efficiency	5	Leaching regime of irrigation
3	Soil water-salt regime	6	Desalinization rate

I	Most recent publications (maximum 3)			
1	Author(s): N.Reshetkina, Kh.Yakubov			
	Title: Vertical drainage			
	Publication details: Principles of irrigated lands zoning according to type of drainage, main requirements to initial data selection are considered. Multicriterial analysis of field investigations results on soil desalinization and water use improvement under leaching regime of irrigation is used. Main principles of water pumping regime of VDS with regard to groundwater use for irrigation permitting to create optimal reclamation regimes over irrigated lands.			
	Year of publication: 1978	free access <input checked="" type="checkbox"/>	restricted <input type="checkbox"/>	confidential <input type="checkbox"/>
2	Author(s):			
	Title:			
	Publication details:			
	Year of publication:	free access <input checked="" type="checkbox"/>	restricted <input type="checkbox"/>	confidential <input type="checkbox"/>
3	Author(s):			
	Title:			
	Publication details:			
	Year of publication:	free access <input checked="" type="checkbox"/>	restricted <input type="checkbox"/>	confidential <input type="checkbox"/>