

REGISTER OF RESEARCH ON IRRIGATION AND DRAINAGE

QUESTIONNAIRE

A	Project title: Water use improvement and soil water-salt regime management on the background of vertical drainage.
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B	Topic n° :2	Sub-topic n°: 2
1)	2	Technical field n°: 3
2)	Category n°: 01	

C	Project location:		
	Country: Republic of Kazakhstan	Area: 500 ha	
	South Kazakh province, Turkmen district, collective farm «Communizm»		

D	Duration of the project		
	Year in which the project was started: 1971	Project completed: 1975	
		Dates of Expertise: 1975	

E	Organizations and technical staff involved			
1	Supervisor/project coordinator: Vishpolsky Franz Organization: KazNIIVH Address: 12, Koigeldy, Taraz telephone: 2 49 65----- fax: 7 E-mail:			%
				Staff resources 100
	Other counterparts:	Organizations	Surname	First name
1				%
2				%
3				%
4				%
	Other collaborators:			man-years

F	Funding agencies	
	Full name or acronym	Percentage of project finance provided
1	Ministry for Land Reclamation and Water Management	100%
2		%
3		%

G	Summary of research project
<p>1 Objective and technical fields:</p> <p>Prevention of irrigated lands' salinization on the base of drainage improvement and irrigation leaching regime</p> <p>Objectives: Soil water-salt regime management, irrigated land water supply increase, ecological situation on adjacent lands improvement at expense of drainage water use for leaching and irrigation</p>	
<p>2 Scientific and technical approaches:</p> <p>Irrigated lands desalinization and soil productivity increase on the base of salt removal from soil and groundwater by means of optimization of irrigation regime and groundwater discharge.</p> <p>Importance: Development of the set of reclamation measures for acceleration of soil desalinization and its productivity increase, irrigated lands water supply improvement, water consumption rate decrease and agricultural production economic efficiency increase.</p>	
<p>3 Environment characteristics:</p> <p>Climate is continental and has a high termic regime and air aridity. Average annual air temperature is 13 -15⁰C. Maximum is 10-40 °C, minimum 20-25⁰C. Mean-decade temperature higher than 14⁰C is kept within 6 months, since mid - April till mid - October. Precipitation is 145-220 mm/year. Evaporativity is 1200-1400 mm/year. Mean annual humidity is 50-60%; 85% in Winter and 20% in Summer. The relief is typical for premountain zone. Surface is slightly corrugated with slope 0,002-0,006 and is constructed by quaternary sediments. Pilot site is characterized by tertiary cretaceous sediments (clay with gypsum, conglomerate, limestone) which can be exposed on depth of 20-25m under quaternary depositions. These latter are constituted by heavy loess loam, light loam and sandy loam. There are thin inter-layers of clay and conglomerate. Under fine-grained rocks there are gravel-pebble sediments with sandy filling. There is a good hydraulic connection between the aquifers. Volumetric mass of unsaturated zone soil varies within wide diapason from 1,35 to 1,55g/cm³; specific mass is 2,64 - 2,70 g/cm³. Porosity is 43,5- 49,5%, natural moisture (in spring) is 13-18%. Water specific yield is 0,1-0,12; full field moisture capacity (FFMC) at the limit is 0,16-0,3 m/day for soda-soils and 0,3-0,5 for non-salinized and salinized soil. Salinity was from 0,17% (allowable limit is 0,2%) to 0,69%. Salinization type chloride-sulphate. Groundwater level was 1-2m in spring and 2,2-3,2 m in autumn. Water salinity was 1-2 g/l, chemical composition chloride-sulphate. Water salinity pumped by vertical drainage was 0,5-0,6 g/l. Composition chloride-sulphate.</p>	
<p>4 Projects and Technical Solutions:</p> <p>Pilot site's is 500ha. Water supply was performed from irrigation canal P-33-3 and vertical drainage wells . There were 5 wells with depth 25-30m screens were sandy-gravel. Screen length was 15-18 m, well discharge was 45-59 l/sec. Two fields were used for soil water-salt regime study under vertical drainage operation.</p>	
<p>5 Methodology:</p> <p>Field observations on water and salt movement, water -salt balance elements formation within unsaturated zone and quaternary aquifer were carried out. These observations were connected with irrigation and leaching regime. Pilot plot was equipped by devices for measurement of water and salt, moisture and salt exchange between different aquifers. Multicriterual analysis was undertaken to process data obtained.</p>	
<p>6 Results:</p> <p>Regular irrigation began to develop since mid - thirties over a few hundreds of hectares from Karachic river. After Arys-Turkestan canal construction new lands were developed that caused groundwater level increase, soil salinization and soil productivity decrease. The pilot plot for observation of vertical drainage influence on land reclamation conditions has been</p>	

constructed in 1970. There were 5 vertical wells located according to «envelope» scheme. During two first years of pumping inflow from outside was about 60-70% from the discharge and groundwater level was decreasing within 1 cm since spring till autumn. After vertical drainage system construction on upper lands inflow decreased to 30%. Volume pumped from 3 wells for irrigation was define by irrigation regime.

Vertical drainage system construction allowed:

- ground water level regulation within wide limits; during the first years level was decreasing since spring to autumn from 1-2m to 2-3m, but later it decreased from 1-2m to 2,5-3,5 m. Piezometric head has changed from +0,1-0,2m to -0,1-0,3 m relating to groundwater level;.
- groundwater level decrease rate management form 1 to 4cm/day, unsaturated zone desalinization rate by means of groundwater over flow provision from cover loam to captured aquifer.

During 3 years of studies on cotton irrigated fields one water-storage irrigation (1500 -2000 cm.m/ha) and two vegetation irrigations were undertaken. Threshold of moisture before irrigations was 60-70% of FFMC. Average annual water duty was 6000-6500 cm.m./ha. On irrigated lands where cereals were undertaken. Average annual water duty 4500 -4800 cm.m/ha. Total evaporation was 7,800-7,200 cm.m/ha in the first cause and 6800-7200 cm.m/ha in the second one. Water duty plus precipitation (B+O_c) to total transpiration (T+N) ratio was 0,96- 1,12 for cotton field and 0,87-0,99 for cereal one. During 3years salinized land development by means of cotton growing salt stock, within the unsaturated zone was decreasing on 10-60 t/ha but in groundwater it was increasing on 6-30 t/ha (depending on the distance from the vertical drainage system) under (B+O_c) to (T+N) ratio equal 0,96-1,12. Heavy irrigations application (1300-1600 cm.m/ha) when infiltrated water salinity exceed 3 g/l. Groundwater pumped outflow deep aquifer salinity was increasing every 500 - 1000 m downwards the slope on 0,1-0,15 g/l. Under ration(B+O_c) to (T+N) decrease to 0,87-0,99 unsaturated zone desalinization has been discovered only on 100-150m distance from vertical system where groundwater flow direction changed most intensively between aquifers of cover loam and pebble -gravel. On non-salinized lands salt stock within unsaturated zone was increasing or decreasing within 2 t/ha year, that testifies soil-reclamation situation stability. Under autumn leaching irrigations on the vertical drainage background water specific discharges for 1 t salt removal were: 45-50 cm.m from upper 1 m layer, 70-75 cm.m from unsaturated zone. Under summer leaching irrigation these indices increased 2,0-2,5 times. The scientific research main result is annual water consumption rate decrease on 1,0-1,5 th.cm.m/ha, cotton yield increase from 1,5 to 2,5 t.ha, irrigated land water supply improvement at expense of groundwater use for irrigation. Vertical drainage system (VDS) operation and irrigation regime adjustment provided VDS operation during 2-3 months shorter period. Economic effect was 200-250 rouble/ha.

H	Suggested key-words		
1	Water-salt regimes	4	Irrigations leaching regime
2	Water consumption rate decrease	5	Groundwater pumping regime change
3	Groundwater level decrease and desalinization rate	6	Irrigated lands productivity improvement

I	Most recent publications (maximum 3)			
1	Author(s): F. Visjpolsky			
	Title: Vertical drainage and water resources rational use in the Arys-Turkestan canal's command zone.			
	Publication details: Field investigation's results on conjunctive surface and groundwater use for irrigation and soil water-salt regime formation are described. Main provisions on water resources management at expense of groundwater supply use and restoration are shown.			
	Year of publication: 1976	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 type="checkbox"/>	restricted <input type="checkbox"/>
3	Author(s):		
	Title:		
	Publication details:		
	Year of publication:	free access <input type="checkbox"/>	restricted <input type="checkbox"/>