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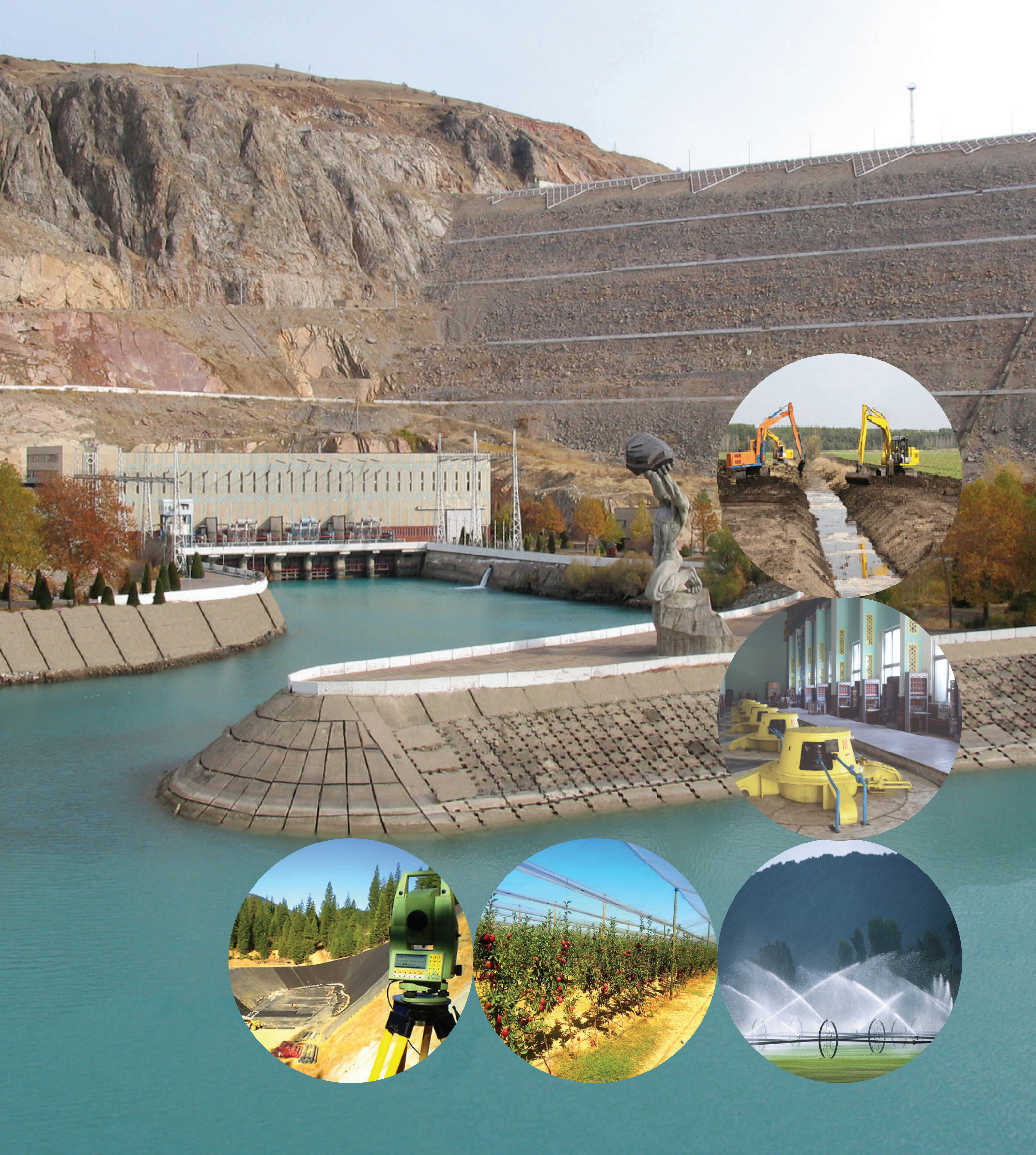

Муассис:
Тошкент ирригация ва мелиорация институти (ТИМИ)

Манзилимиз: 100000, Тошкент ш., Қори-Ниёзий, 39. ТИМИ

E-mail: ***i_m_jurnal@tiim.uz***
internet: ***www.tiim.uz***

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UP-TO-DATE MELIORATION STATE OF IRRIGATION AREA OF THE HUNGRY STEPPE (UZBER PART) AND WAYS OF SUSTAINABLE INCREASING THEIR PRODUCTIVITY

Ikramov R.K., Research Institute of Irrigation and Water Problem in TIIM,
Begmatov I.A., Tashkent Institute of Irrigation and Melioration.

Аннотация

Ушбу мақолада янгича интеграциялашган усуллар бўйича суғориладиган ерларнинг бугунги кундаги ҳолати ва мелиорация жараёнларни баҳолаш тадқиқотлари натижалари келтирилган. Тадқиқотлар маъмурий туманлар кесимида бажарилган ва ҳар бир туманда мелиоратив ҳолатни яхшилаш бўйича тавсиялар берилган.

Abstract

The results of investigation on assessment of up-to-date melioration state of irrigation lands, ameliorative processes and regimes on proposed new integrated modification method are introduced in this paper. Investigations were fulfilled mainly via administration raions. Recommendations were done for improvement melioration state on each raions.

Аннотация

В данной статье представлены результаты исследования оценки современного состояния орошаемых земель и мелиоративных процессов по новому интегрированному методу модификации. Исследования были выполнены по административным районам. Даны рекомендации по улучшению мелиоративного состояния каждого района.

Preface.

Most of 8,0 mln. ha of irrigated lands in the Aral Sea basin demands of rehabilitation and reconstruction. It is important to analysis of real state of irrigation lands, melioration regimes, functioning of irrigation and drainage systems in connection with their technical state.

Purpose of project. Assessment on big irrigation system up –to- date melioration processes,

to define connection of ameliorative state of irrigation area with water supply, draining the territory, salinity of irrigation water and technical state of irrigation and drainage systems, then elaboration measures for improvement of ecological and melioration situation, increasing sustainable productivity of agricultural crops.

Materials and methods.

It was used for each raion data of state water management and agricultural monitoring net, and own observation and measuring data (water delivery, irrigation, outflow, subsurface water, soil salinity, technical state of drainage systems, their parameters).

Common and special (aeration zone, subsurface water, root zone) water and salt balance on each month calculated by equation /1/

Assessment of water supply calculated on the equation (1)

$$B_3^{ВП}\eta_C + B_{КДС} \langle K_B^{ВП}[O_P]^{CB}\psi^{CB} \qquad (1)$$

where, $B_3^{ВП}$ - per capita water intake for vegetable period, m³/ha; η_C - efficiency of irrigation systems; $K_B^{ВП}$ - coefficient of allowable decreasing of irrigation norms for decreasing crop yield for 10% from maximal meaning /2/.

$[O_P]^{CB}$ - average irrigation norms for adopted agricultural crops under irrigation water salinity to 1 g/l; ψ^{CB} –average meaning of correcting coefficient increasing irrigation rate for using water salinity. ψ - meaning adopts from the mathematical modeling of optimal melioration regimes /1/.

$$[O_P]^{CB} = \frac{O_P^1 f_1 + O_P f_2 O_P f_3 + \ldots + O_P^n f_n}{\sum_{i=1}^{n} f_i} \qquad (2)$$

where, $O_P^1, O_P^2 \ldots$ – irrigation norms of each agricultural crops for appointed hydromodul raions;

f_1, f_2, f_3 - different crop occupied area.

Water supply in no vegetation period (November - April) are calculated from equation (3)

$$B_3^{MB}\eta + B_{КДВ} < K_B^{MB}[B]_{MB}^{CC}\psi^{CC} \qquad (3)$$

Water demand for no vegetation period defined by equation (4)

$$[B^{MB}] = \sum_{i-S_O}^{S}\sum_{0}^{F} N_{ij} f_{ij} + \sum_{i-1}^{n} m_j^{B3} f_j^{B3} \qquad (4)$$

Where, N_{ij}, f_{ij} – leaching rate and area with *i*- rate of salinity; *j*- soil mechanical content; S, S_O – inception and allowable soil salinity; m_j^{B3} - norms of irrigation water with *i* – soil mechanical content; f_j^{B3} - area with i- mechanical content of soil for irrigation; K_B^{MC} - coefficient allowable decrease of water supply in no vegetation period. Special investigations must be done for its defining. It was adopted as K_B^{MC}.

Coefficient of salt leaching regime of irrigation could be calculated by equation (5)

$$K = \frac{В_д + О_с + В_{кдс} + В_{вд} - С_п}{ET_д} \qquad (5)$$

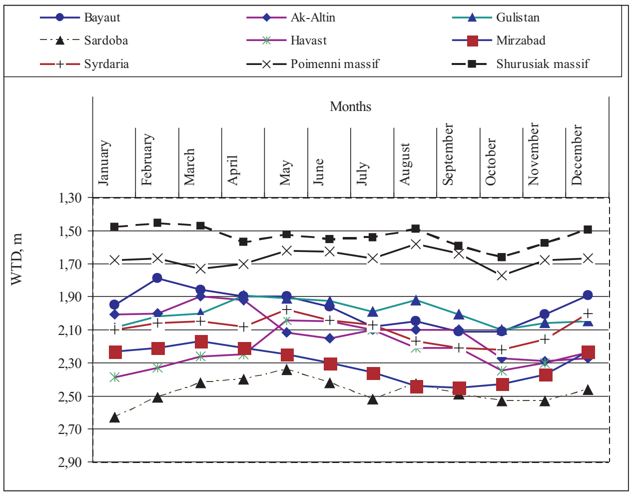

Fig 1. Dynamics of water table depth on adminictrative raion on Hangry Steppe (uzbek part)

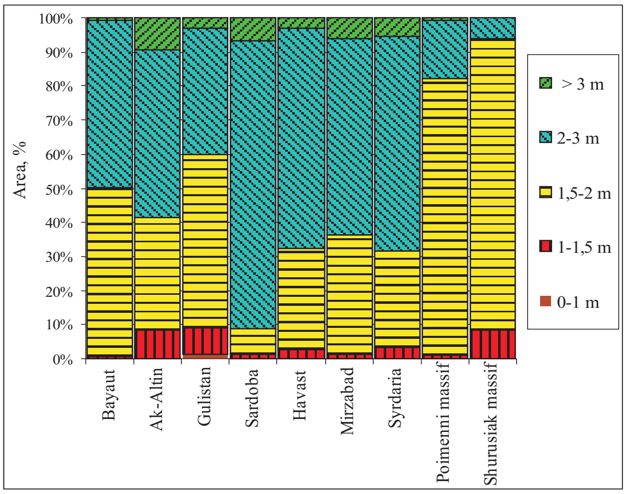

Fig 2. Water table distribution area on adminictrative raion for vegetation period

where, $B_д$ – irrigation water from canals, m³/ha; O_c – atmospheric precipitation, m³/ha; $B_{кдс}$ – irrigation water from drainage system, m³/ha; $B_{вд}$ – irrigation water from vertical drainage, m³/ha; Сбд –run-off water from field, m³/ha; $ET_д$ – evapotranspiration from field, m³/ha.

Coefficient of draining calculate by equation (6)

$$K_Д = \frac{Д_Г + Д_В}{B + O_C + Ф_{МК} + П - О - С} \quad (6)$$

where, $Д_Г$ – run-off subsurface water by horizontal(tile or open canals) drainage, m³/ha; $Д_В$ – volume of water, pumped from vertical drainage, m³/ha; B- water intake to raion,m³/ha; O_c – atmospheric precipitation, m³/ha; $Ф_{мк}$ –infiltration losses from main canals, m³/ha; П –ground water inflow from neighboring territory; О –ground water outflow from observing area; $C_п$ – run-off irrigation water from fields.

Results and discussion

Hungry Steppe is a waste inters mountain plain, situated on the left bank of middle stretch Syrdarya river. Uzbek part of Steppe situated in Syrdarya oblast with 8 agrarian raions.

It is irrigated here 287 thous. ha land from common 427,618 thous. ha territory. Climate acute continental with perennial average precipitation 260-312 mm.The North part of plain (“old zone of irrigation”, with beginning irrigation from 1912). Less type loam soils with thick 15-40 m covers gravel and sand deposition. The South part of Steppe (“new zone of irrigation” from 1958) consist of deluvial and proluvial deposits mixed with peripheral part of temporary river flood alluvial of rivers formed on Turkistan mountains.

Mechanically soils consist of dominated average and light loams (more 60%), others heavy loam and clay soils. Most of Hungry Steppe soils have inception high fertility. Up - to-date 222 thous. ha irrigated area saline, 117 thous.ha average and heavy saline soil. An area with shallow subsoil water table (till 2,0 m) reaches 83 thous.ha. and with subsoil water salinity above 3 g/l covers 204,0 thous.ha.

Cotton is a main irrigation culture (37% of irrigation area) and winter wheat (30%). Gross value of cotton - 250344 tn and wheat- 356318 tn (2011). Furrow irrigation dominated here but his efficiency rather low (0, 60) because of absence land leveling last 20 years.

Melioration of saline soil in “old irrigation zone” (Syrdaria, Gulistan, Saihunabad, Bayaut and part of Mirzabad raions) support mainly by vertical drainage and open run-off drainage (30 m/ha), in “new irrigation zone” fulfill by tile drainage and run-off open drainage (75 m/ha)

Subsurface water table changed in the next range in vegetation period 0f 2011 (Fig 1)

Water table with depth 1,5-2,0 m reaches 45-85 %, with depth 2-3 m 7-51 % in Saihunabad, Gulistan and Bayaut raions. Water table with depth 2-3 m dominates (62-92 %) in most area of Ak-Altin, Sardoba, Havast, Mirzabad, and Syrdaria raions (Fig 2).

Moderate salinity (1-3 g/l) of subsurface water table observed in 50-83 % area of Saihunabad, Gulistan and Syrdaria raions, average salinity (3-5 g/l) in Bayaut, Ak-altin, Havast and Mirzabad raions, high salinity (5-10 g/l) in Sardoba raion (Fig 3).

Dominated raions at the end of vegetation period of 2012 have area (77-96 %) with weak salinity soil, area with average salinity soil (1-20 %) and only Mirzabad raion have average soil salinity on the 50 % of its common area (Fig 4).

It was calculate for all raions common and particular water –salt balanse for 2010 - 2012. Result of it were gaven as common water salt balances for massifs and root zones of agricultural crops. Examples are given for two massifs of Saihunabad raion of “old irrigation zone” and Ak-Altin raion in “ new irrigation zone “ of Hangry Steppe (Fig 5).

ΔC- common stock of salt in massif, tn/ha; $ΔC_{кс}$- common stosk of salt in root zone of soil, tn/ha; $ΣC_{бр}$- total run-off irrigation water, m³/ha

These culculations indicates of slow processes of soil desalinisation 2-3,5 tn/ha annually, and common salt balances from +1,9 to -10 tn/ha. Such balance calculation is a actual model of melioration processes on irrigated area. Using these data we could do prediction calculation on assessing impact of different measures on melioration state of land and yield of agricultural crops.

Analised data indicate on nonsafficient state of melioration states of land. Collected data of water and salt balanse are used to assesess water demand, creating leaching irrigation regimes, improve existinng state of artificial drainage.

In all raions of Syrdaria oblast water resourses are used with low efficiently (30-50 %) in non vegetation period. It was observed deficite (70-76 %) of water in vegetation period in Ak- Altin and Sardoba raions, overusing water(140 %) only

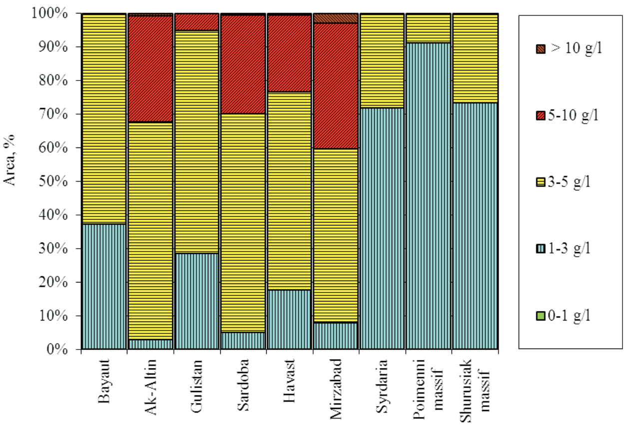

Fig 3. Distribution area of water table with different salinity on adminictrative raion for vegetation period

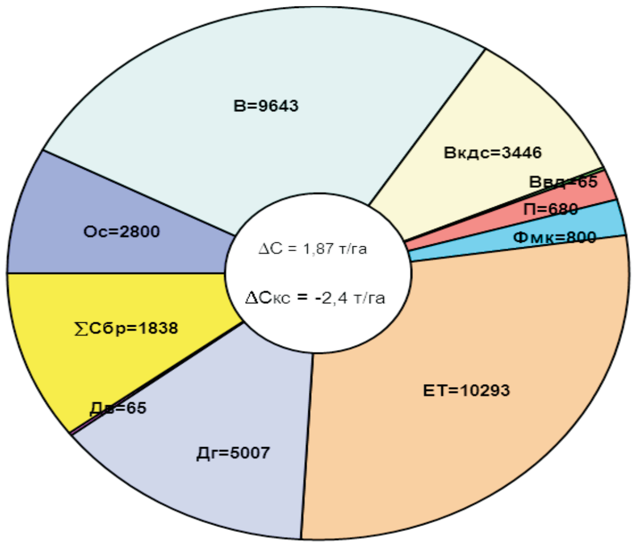

Fig 5. Water-salt balance for massif Poimenni of Saihunabad raion, m^3/ha; tn/ha (2011-2012)

in Saihunabad raion.Other raion's water supply was about norm. (Fig 6)

In spite of extra water resources in Syrdaria river basin in winter period, it is non adequate low water supply(30-50 %) in nonvegetation period in all raions. Such situation could be explaned that farmers pay poor attetion to salt leaching processes, low technical base of farmers, deficite of fuel and labour forse. Annual salt leaching rate from soil rather low (0,77-1,09) comparing with recommendations of SANIIRI (1,15-1,25).

In Syrdaria, Gulistan, Saihunabad, Bayaut and part of Mirzabad raions territory drained mainly by vertical drainage and run-off open collectors (70-77 %), in Ak-Altin, Sardoba, Havast, Mirzabad, and Syrdaria raions irrigation territory are used tile horizontal drainage (46-92 %).

Yield of cotton and winter wheat in Syrdaria, Gulistan, Saihunabad, Bayaut, Ak-Altin and Sardoba raions were different and assessed as "good" with 2,0- 2,8 tn/ha on cotton 3,0 – 5,4 tn/ha. In Havast and Mirzabad raions yield of cotton reached 1,5-1,6 tn/ha and winter wheat 2,2-2,8 tn/ha . It means that average yield of crops depends mainly on soil salinity.

Conclusions and Recommendations

On "old' irrigation zone. During 2009-2012 it was observed slovly elevation of subsurface water table in Syrdaria, Gulistan, Saihunabad, Bayaut raions, their level are different from recommendations of SANIIRI 2-3 m /1/. Subsurface water mineralization is decreasing. In Gulistan and Bayut raions area with salinity above 3 g/l is 50-60 %, while in Syrdaria and Saihunabad raions its salinuty below 3g/l. Soil salinity in gradation nonsaline and poor saline in above mentioned raion changes 41,5-75,5 %, average and heavy saline soils 24,5-68,3 %. Yield of cotton 2,2 -2,7 tn/ha and wheat 47-54 tn/ha is assessed as moderate.

Reasons of poor melioration processes. Salinity of irrigation water last 3 years fluctuated in range 8,2-1,75 g/l to 0,3-0,5 g/l adopted in inseption phase of project. Water supply for vegetation period changed in range 0,95-1,23. Non vegetation period in spite of extra water resourses in Syrdaria river basin efficiency of water use was low 0,33-0,49, on the reason of declining of technology of salt leaching and organized circumstances. Annual salt leaching irrigation regimes coefficient reached 0,73-0,78, opposite recommendations of SANIIRI /1/. Coefficient efficiency irrigation system of canals declinig from 0,6 to 0,56. State of interfarm and onfarm collector-drainage systems are in unsatisfactory conditions. In spite of low load to drainage systems, it is observing elevation of high subsurface ground

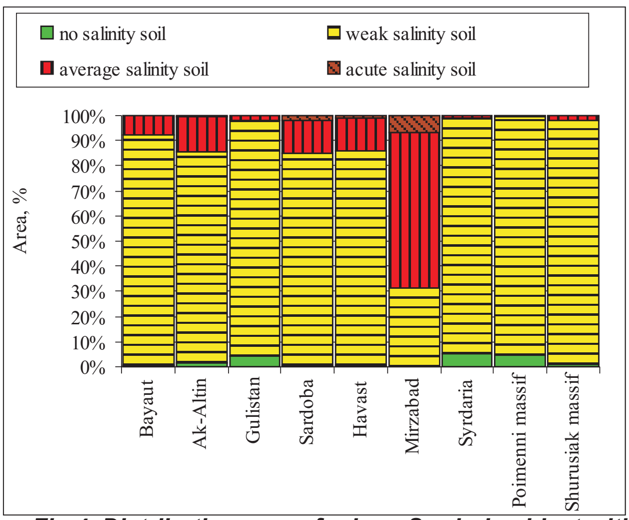

Fig 4. Distribution area of raions Syrdaria oblast with different soil salinity

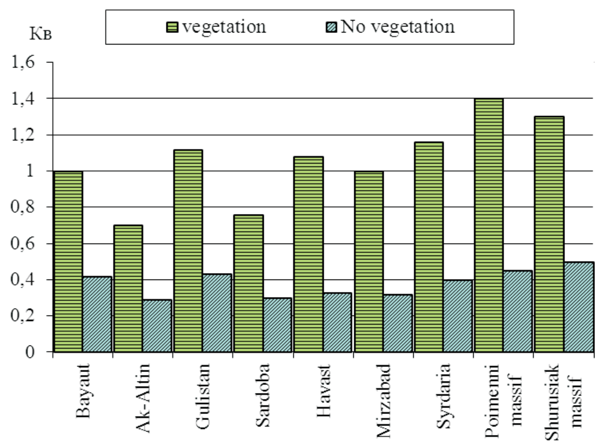

Fig 6. Coefficient of water supply on raions.

water table, which indicate to nonadequate functioning drainage systems. Efficiency of vertical drainage wells decreased to 3-4 times because of long time of exploitation and financial constrains.

On “new”irrigation systems. During observed period in irrigation area of Ak-Altin, Sardoba, Havast, Mirzabad raions it is found elevation of ground water table, but it in average range of recommendation of SANIIRI (2-3 m) in vegetation period. Subsurface water salinity is decreasing, but 82-98 % of area has mineralization above 3g/l and assessed as nonsufficient. Soil salinity refers to no saline and weak saline soil occupies 26,8-63,1 % of irrigated area, other 36,2-73,2 % has average and high salinity. Yield of cotton is rather low 1,14-1,97 tn/ha, winter wheat 2,25-3,48 tn/ha. Only Ak-Altin raion have average yield cotton- 1,99-2,13 tn/ha and wheat 4,35- 4,52 tn/ha

Reasons of poor melioration processes. Irrigation water salinity last 3 years flactuated in range 0,85-1,88 g/l, opposite 0,3-0,5 g/l in incepcion data of project.Water supply in vegetation period 0,7-1,0, and low in nonvegetation period 0,3-0,4 in spite of extra water in Syrdaria river.Reasons of it the same, as in “old” irrigation zone. Annual salt leaching irrigation regimes coefficient reached 0,74-0,9, opposite recommendation of SANIIRI – 1,15-1,25 /1/. Coefficient efficiency irrigation system of canals declinig from 0,72 to 0,62. State of interfarm and onfarm collector- -drainage systems are in unsatisfactory condision (50-60 %). In spite of low load to drainage systems, it is observing elevation of subsurface ground water table, which indicate to nonadequate functioning drainage systems.

Common measures for improving melioration regimes.

Measures for realization without big investments.

1. It is need change melioration regimes from hydromorphic to automorphic, which demand less water and decrease load to drainage systems. In “old”irrigation zone, in vegetation period water intake for irrigation exceed appointed limits, just the same time exists big volume of drainage water with sufficient quality for irrigation use. It must be redistribution of water resourses in Sirdaria oblast, increasing water supply of “new” irrigation zone on the expence of “old”zone, and increasing use drainage water of good quality.These measures assisst to realise salt leaching regimes in “new” irrigation zone and improve melioration state of area

2. Land levelling, if it possible using laser beam, must be implemented in all territory, to irrigate via furrows with optimal irrigation regimes. These measures assists to unifom distribution of water, prevent soil salinisaton and decrease infiltrarion irrigation water to drainage systems.

3. To improve agro technical measures – optimal density of agricultural crops, application of fertilizer, to use artificial and natural mulching, irrigation via furrow, etc.

4. Improving funtioning existing drainage systems. Cleaning interfarm and onfarm drainage systems from silting and weed, including vertical drainage, impove repairing base, to supply technical resourses, spare parts.

5. Improving salt leaching technology on the base of scientific recommendation.

6 “Old” vertical wells, if it is no efficiency of cleaning and repairing, it must be drilled new one.

It must be used innovation in this process: to use polimer tubes with new progressive technology of construction, to use special sorted filter materials.

Measures, demanding big investments

1. Increasing coefficient efficiency of canal systems by their rehabilitation and reconstraction

2. Capital land levelling irrigated area with using lazer installation.

3. Using water saving innovation technologies: drip irrigations, sprinkler irrigations, subsurface irrigation, discrete irrigation, etc.

Using modern types of drainage - tile horizontal drainage, with buried collectors, combined drainage,etc.

4. Implentation of system of automation and telemechanics on canals, headworks, dams, and on systems of collector and drainage net,vertical drainage wells

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