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FORMATION OF SALT IRRIGATED LANDS OF KARAKALPAKSTAN

Резюме

В работе рассмотрены закономерности солеобразования в почвах на орошаемых землях республики Каракалпакстан. На основе данного анализа выводится, что основным мероприятием направленным на предотвращение и снижение солевого накопления на орошаемых землях региона должны быть осуществлены на снижение уровня грунтовых вод ниже критической в зависимости от величины минерализации и достижения опреснения грунтовых вод.

Key words: Salt Accumulation; Underground Water; Irrigated Lands; Collector Water; Mineralization.

Introduction. Along the down-stream parts of Amu Darya river, including in the parts in the Republic Karakalpakstan accumulation of salt in the soil has been active for a long-term. . Salt accumulation in the irrigated lands of the region originates from:

- from the irrigation water (salt in the Amudarya water);
- from the dried bottoms of the Aral sea, transported by wind;
- from salty underground waters transported up in soil profile to the surfaces.

Salt from irrigation water. The amount of salt resulting from irrigation has changed considerably with time. Until the 1960-s mineralization of the Amudarya water was between 0,350 and 0,590 gram/liter, and for centuries it has been the basic source of salt accumulated on irrigated lands. During the last 3-4 decades the river's salinity level has sharply increased and for a period reached up to 2,5 gram/liter. A reason for this has been dumping of collector waters (spill-water from irrigation canals) along the river. Because of reduction of the amount of water of Amudarya river during the last years, the amount of salt transported on to the irrigated fields was also considerably reduced. Average annual amount of salt reaching the soils this way is 16 tons/hectare.

Salt from the dried bottoms of the Aral sea transported by wind. Here the existing data differ strongly. The Central Asian research institute of irrigation has during the last three years carried out research on the quantitative and qualitative characteristics of the salt, transported from dried bottom of the Aral sea by northern wind to irrigated lands of the Republic of Karakalpakstan. According to these investigations the number varies between 0,7 and 2,2 tons/hectare, with an average of 1,2 tons/hectare [1].

Salt from salty underground waters transported up in soil profile to the surface. This process is the most important one resulting in salt accumulation in irrigated lands of the Republic of Karakalpakstan. As a rule, when the ground water table is close to the land surface the evaporation from a surface is high and salt collects on the surface of ground. The amount of salt accumulation at the soil surface depends on the mineralization level of the underground waters.

At the certain amount of evaporation from the ground water and level of mineralization M_r of the ground water it is possible to determine the level of salt accumulation in the upper soil [2] by the following formula:

$$S = E_0 \left(1 - \frac{h_0}{h_k}\right)^n M_r$$

Table 1 below describes the value of salt accumulation (S) for different values of h_0 and M_r .

Table – 1. Salt accumulation on soil lands in accordance with different meanings of M_r and h_0 .

h_0	Salt accumulation on soil surface (tons/hectare) for different M_r				
	2gram/liter	3 gram/liter	5 gram/liter	7 gram/liter	10 gr/liter
0,5	16,4	24,9	41,4	58,0	82,9
1,0	14,9	20,9	34,9	48,9	69,9
1,5	8,9	13,4	22,3	31,2	44,6
2,0	6,2	9,4	15,6	21,8	31,2
2,5	2,7	4,0	6,8	9,5	13,5
3,0	0,5	0,7	1,2	1,6	2,4

Table-1, thus, shows that the amount of salt accumulation on soil surface mainly depends on the level of ground water mineralization (M_r). For example, at M_r equal to 3gram/liter there is almost no salt accumulation on soil surface, but at M_r equal 10gram/liter the accumulation reaches 82,9 tons/hectare.

According to these calculations for the conditions of Karakalpakstan where the mineralization of ground water are within 3 to 6 gram/liter, and level of underground water on irrigated lands within 1,8 – 2,5 m, the salt accumulation on soil surface are between 4 – 24 tons per hectare [3].

Thus summarizing, the amount of salt accumulation on irrigated lands by the different, described processes shows the following numbers:

Salt transported by irrigation water (river Amu Darya) - 15-16 tons per hectare;

Salt from dried bottom of the Aral sea (salt transported by wind) - 1-1,2 tons per hectare;

Salt from ground water in irrigated lands (depending on M_r) - 4-24 tons per hectare.

So, total amount of salt accumulation on the surface of soil are within 20 to 50 tons per hectare.

Conclusion. On the basis of above carried analyze we may conclude that by the basic measure directed on prevention (or decrease) of salt accumulation on irrigating lands of Karakalpakstan should be carried out on lowering of a level of underground waters below critical (depending on M_r) and desalinization of these underground waters. Of course salt transported by Amudarya River plays also crucial role on salt accumulation, almost 50% (15-16 tons per hectare), but we cannot decrease it by this factor unless we stop the dumping of collector waters along the river, especially on upper parts of the river. These projects, which allows dumping of collector waters to river without cleaning it were realized more than 50 years ago (during the Soviet time). Contemporary projects do not allow collector waters spill to Amudarya river without preliminary cleaning it.

Sources:

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