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MELIORATION AND ECOLOGICAL STATE OF SOILS, BASED ON DRAINING DEGREE OF KURA-ARAS LOWLAND

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The factors, influencing melioration and ecological state of Kura-Aras lowland according to draining degree have been defined and water composition of Kura-Aras lowland have been studied. Melioration and ecological state of soils, depending on water balance, have been studied
Keywords: *drainage, ground water, irrigation, soils, ecologic state*

Були визначені фактори, що впливають на меліорацію та екологічний стан Кура-Араксинської низовини відповідно до ступеня дренажу і був вивчений склад води Кура-Араксиньскої низовини. Були вивчені меліорація та екологічний стан ґрунтів, залежно від водного балансу
Ключові слова: *дренаж, підземні води, зрошення, ґрунти, екологічний стан*

1. Introduction

One of main factors at evaluation of melioration-ecologic state of soils is study of degree of natural drainage of areas. Thus, study of degree of natural drainage allows developing measures, directed to protection of surrounding environment, rehabilitation of ecologic balance and melioration (improvement) of soils [1].

Natural drainage degree may be defined by means of balance method, i.e. on base of total water balance and "balance on ground water". Analyzes indicate that both water balances allow clarifying the general view. However, depending on specific situation, several difficulties are arisen during its application. For example, while formation of "ground water balance" of such region, as Kura-Araz lowland, which is complex one from morphologic, hydro-geologic and orthographic view point, it is really difficult to define nutrition with water under pressure, streams penetrating to lowland and discharging from it through underground. For definition of these volumes, it is necessary:

– to establish observation networks, consisting of piezometers, covering the whole hydro-geologic diversity,

– to conduct systematic observations during the whole year and finally,

– to process obtained multiyear data.

Additional example, for definition of streams, penetrating in and discharging to ground surface, the unique method and/or measuring device hasn't been established hitherto. One more example, for definition of evaporation, evolved from surface of ground waters and volume (transpiration) of water, used by plants, hundreds of lisimeters are to be installed and daily and even hourly and momentary observations for the whole year period are to be conducted by them. It is possible to present a number of such examples. However, it is easy to execute such works at small test-production areas, and researchers may easily cope with such type of works. Specialists and specialized state institutions are dealing with formation of regional water balance. Thus, for study and definition of drainage degree of Kura-Araz lowland, data of individual researchers and scientific organizations were applied (2–6).

2. Analysis and discussion of research

It is necessary to note, that more than 90 % of irrigated areas is concentrated in the Kur-Araz lowland. Therefore, during formation of water balance, along with other deliverable elements, losses from channels are to be included into (Total water supplied for irrigation) supplying part of balance. However, while defining the degree of natural drainage, it is necessary to take conventionally into account flow of collector-drainage water. The equation of balance of total water balance is expressed, as follows:

$$\pm W = O_p + A + \Phi_k + (\overline{\Pi} - \overline{O}) + (\underline{\Pi} - \underline{O}) + \\ + Ç \pm P - (U + T_p) - D_p - D_k, \quad (1)$$

where O_c is volume of water supplied for irrigation; A – atmospheric sedimentation; Φ_k –leakage losses from all type of channels; $Ç$ – filtering losses from rivers; $\underline{\Pi}$, $\underline{O}$ – streams, penetrating into/ and discharging from ground surface; D_k – water volume discharged by means of collectors to Caspian sea; P – volume of water under pressure; Dp – flowing of ground waters by means of rivers (volume of drained water of rivers; U – evaporation; T_p – water volume used by plants and/or transpiration.

Balance elements are expressed in mm and/or in m^3/ha.

According to data, collected for many years in average, 12 bln/m^3 of water is supplied. Lowland area amounts about 2.2 mln hectares. Water supply rate per each hectare during 1 year period is, as follows:

As a result of meteorological observations were conducted in different regions of Azerbaijan, 200–450 mm of rainfall [3, 5], fall on Kura-Araz lowland per year.

In such case, average volume of atmospheric sedimentation per each hectare is:

$$A = 300 \cdot 10 = 3000 \text{ m}^3/\text{ha},$$

$$Q_p = \frac{12 \cdot 10^9 \text{ m}^3}{2,2 \cdot 10^6 \text{ ha}} = 5455 \text{ m}^3/\text{ha}.$$

Leakage losses from all types of channels are defined by operating efficiency (η) of these channels by means of below indicated expression:

$$\Phi_к = O_p(\frac{1}{\eta} - 1). \quad (2)$$

Presently, operating efficiency of the channels is equal, in average to $\eta = 0,70$.

In such case, leakage loss from channels is:

$$\Phi_k = 5455 \ (\frac{1}{0,7} - 1) = 2338 \text{ m}^3/\text{ha}.$$

There is no free discharge of ground water in Kura-Araz lowland and the specialist on hydrogeology sciences and scientists confirms the absence of underground flow [4, 5]. Therefore, Q=0.

Surface water penetrates to Kura-Araz lowland at a result of melting snow from slopes of the Southern part of the Talysh Mountains, the Greater Caucasus and the Lesser Caucasus mountains and rainfall. The bigger part of surface streams penetrating to rivers inside lowland, smaller part flowing to proluvial plains, alluvial-proluvial and deluvial-proluvial plains [5], penetrates to soil.

On base of calculations flow consumption on ground surface is 10 m^3/sec and/or 234 m^3/ha. (5). Taking into account regularities of formation of ground water regime of Kura-Araz Lowland and according to researches of scientists, including G. Y. Israfilov (5), A. K. Alimov (3) and others, dealing with water salt balance, the mountain slopes, surrounding lowland are meager from view point of ground water. Underground water flows into lowland area, as marginal springs, underground water supplies and black water. Total consumption of this makes 3.4 m^3/sec and/or $79,6 \text{ m}^3/\text{ha} \cdot \text{year}$.

On base of conducted researches, rivers passing inside lowland, are subjected to losses in some parts, while passing, i.e. rivers feed ground waters in these areas. Water losses at such time in internal rivers is 44.55 m^3/sec and/or 1044m^3/ha [5].

Presently, on base of formed condition and existing state, due to increase of water in Kura river, which is the only draining river in Kura-Araz lowland, its draining capacity (degree) is weakened much. Increase and decrease of nutrition level and drainage of ground water in the river creates compensation. Thus, practically, it is possible to disregard the volume of ground water, discharged into Caspian Sea via rivers.

3. Melioration and ecologic state of soils, based on draining degree of Kura-Araz lowland

According to experiments on lisimeters and calculations of individual researchers volume of total evaporation (evaporation+ transpiration from soil) in Kura-Araz lowland makes in average 850+1150 thous. i. e. $U + T_p = (8500 + 11500)/2 = 10500$ m^3/ha [3, 5].

Volume of water by means of existing collector-drainage system, water volume, discharged mainly by means of main collector into Caspian sea, is 4.3 bln/ m^3 (3).

Volume of water, flowing from irrigated soils of lowland for the whole year period per hectare is:

$$D_k = \frac{4,3 \cdot 10^9}{2,2 \cdot 10^6} = 1955 \text{ m}^3/\text{ha}.$$

Thus, total water balance of the Kura-Araz lowland is reflected on base of these values in the composed table on water balance (Table 1)

Table 1

Total water balance of Kura-Araz lowland (Total area of the lowland is 2.2 million hectares)

Ser.No.	Balance elements	Value of balance elements m^3/ha	Total %
1	Supplying part Water supplied for irrigation, Q_p	5455	40,7
2	Atmospheric sedimentation A	3000	22,4
3	Leakage losses discharged from all type channels	2338	17,4
4	Nutrition by water under stress	649	4,8
5	Losses formed in rivers inside lowland	1044	7,8
6	Stream flowing from surface of slopes of mountain	234	1,7
7	Stream flowing by underground	695	5,2
Total		13415	100
1	Outgoing (discharging) part Total evaporation (evaporation+ transpiration) $U+T_p$	10500	80,4
2	Stream flowing to Caspian sea by means of collectors (drainage areas) D_k	1955	15,0
3	Stream flowing above ground $\overline{O}$	0	4,6
4	Stream flowing under ground $\underline{O}$	610	
Total		13065	100
Difference of supply and discharge			

As it is seen from composed water balance, supplying part of balance is much bigger than its discharging part. The prevailing part of water, penetrating into lowland, is compensated by means of evaporation and transpiration. Physical evaporation comprises 80,4 % of discharging part of balance. And this leads to collection of harmful salt and high salination. Despite on activity of collector-drainage networks in lowland water of different sources is not removed in time. Natural drainage degree of the area is in very low level, i.e. Qq<Qc.

Analysis of composed balance allows clarification of additional issue. The point is, functioning of existing collector-drainage network, constructed for draining of irrigated soils of the lowland, is in unsatisfactory state. Actually, there is serious need for construction of new collector-drainage networks in irrigated areas of lowland and, at the same time, for reconstruction (rehabilitation) of existing networks. It is evident from composed total water balance, natural melioration and ecologic balance of areas was changed in the Kura-Araz lowland as a result of ground waters and its impact. For restoration of this balance, the development of system of corresponding measures is one of most urgent problems at the present stage.

One of measures on rehabilitation and improvement of melioration and ecologic state is the application of water discharged by means of collector-drainage networks at irrigation of agricultural plants and watering of salinated soils [2].

Thus, it is possible to decrease significantly water volume taken from fresh water sources (mainly, rivers) for land lots and to remove strained situation, created at water balance.

4. Conclusions

Streams, flowing into the area of lowland for regional total water balance water of Kura-Araz lowland are more comparing with streams, discharging from there, and this difference is 350m^3/ha. As a result, raise of ground water level in irrigated soils, increase of physical evaporation and salination of soils occurs, which leads to worsening of melioration and ecologic state of soils.

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