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SHIRAK PLATEAU SOIL HYDROGEOLOGICAL CONDITIONS AND IMPROVEMENT PROBLEMS

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Armenia is a water-short country having insufficient arable land and where intermountain valleys occupy only 10 per cent of the area. Comparatively large dales are Ararat Valley, Shirak Plateau, Masrik Plain and the middle flow valley of the Pambak River. 39 per cent of irrigated land of Armenia is located in these regions and just here are concentrated problems related to high levels of ground water and overdampness of the aeration zone.

For Shirak Plateau, as well as other irrigated land of the province carrying out continues research on both the ground water deepness in specific locations and actual state of mineralization is a primary task and necessity. To find answers to correct solutions of a number of problems related to soil-reclamation state – to raise and maintain fertility is a matter of primary importance.

Keywords: *plateau, deep-water, subsurface water, ground water, salinity, land fertility, soil-reclamation condition.*

Introduction

Shirak Plateau is located in Shirak Province in the north-west of the Republic of Armenia covering over 2700 square kilometers of mountainous area of which 938 square kilometers are not-used for farming, and 28,8 ha is irrigated [1].

Located in the province Shirak and Ashotsk large hollows enclosed by massifs condition of formation of special soil and climatic conditions for agricultural development. Shirak plateau is located 1400 to 1600 meters above sea level, Ashotsk Plateau is 1900 to 2100 meters above sea level, and mountain picks rise 3100 to 4090 meters (at mountain Aragats) above sea level.

In the province the climate in summer is dry, and the winter is long and very cold -the air temperature can go as low as -46C. For Shirak province it is typical abundance of solar radiation, low relative humidity of air and Low annual precipitation (500 to 550mm) [1]. Formation of cultivated plants crop is directly conditioned not only by geography (position of arable land)and land treatment but also soil-and-hydrogeological conditions, precipitation regime, application of advanced technology etc. It is extremely important correct explanation and analysis of natural soil and water conditions, finding regularities of their annual and of many years quantitative changes in accordance with saltiness and deepness of ground water location.

Exceeding of permissible norms of salts in the active basic layer of soil is followed by the plant natural growth and development disorder. The following can cause salt accumulation in soil:

- Small deepness (0 to 3m) of ground water location,
- Supernormal mineralization (0.5 to 0.8g/l) of ground water
- Large content of salt in the mother rock
- Heavy mechanical structure of soil (heavy and average clay sands and clays).

Land of Shirak province in terms of agriculture is evaluated as the best. Black earth forms 69,4 per cent of the province territory, which is a best base especially for technical cultural plants.

Mountain and meadow soils cover 12.1 per cent of the province territory, and chestnut soil – 1.6 per cent [1].

The objective of the work is to analyze and find reasons of the above mentioned phenomena taking place in Shirak plateau and give positive solutions of problems.

Problem statement

There are around 10 soil types and 20 subtypes which causes thermal and water regime upward zoning [1]. These types are located at three elevations, so called soil belts.

- Low mountain (typical are black soils with almost all subtypes, chestnut soils, here and there stony)
- Middle mountain (meadow and steppe soils)
- High mountain (mountain and meadow soils).

Mountainsides of low steepness have been destructed by erosion both the natural and antropogenic erosion of soils are typical to Shirak and Ashotsk plateaus as to the whole province. Natural erosion is a result of winds and water flows (precipitations, floods). To fight against these phenomena forest and field shelter belts are used. Due to erosion impoverishment of soil occurs and humus so important for a plant to grow decreases, necessary structure of the soil destructed and becomes unsatisfactory in terms of land reclamation.

High content of carbonate, mineralization of organisms and vegetation, high lime content, poor vegetation, small humus content (2-3%) [1] are typical for brown soils of Shirak plateau at elevation range from 1400 to 1500m. For Shirak field carbonate black earth as soil generating rocks are alluvial-proluvial deposits. Due to carbonate black earth tillage and irrigation their large part are used for cultivation of crop plants and sugar-beet, for quantity of carbonates drastically decreases at upper elevations. Irrigated agricultural land is not salted, at the same time it cannot be said that the land is in good state. It is known that impermissible amount (less than 0.2%) of salt in soil causes deterioration of land reclamation condition and as a consequence occurs cultural plant yield decrease, disturbance of natural growth. These circumstances enforce to develop an effective and stable form of soil fertility management enabling to raise the soil productivity using different measures, optimal usage of fertilizers, management of water regime, agrarian amelioration measures etc. State of agricultural land reclamation is also directly conditioned by effective use of water resources.

Natural waters are complex, multi-component systems of which composition is in constant change due to running therein physical, biochemical, biological processes, running ion-exchange reactions with deposition layers, colloid and disperse mixtures sedimentation.

Ground waters are formed as a consequence of natural process and may content over 60 chemical elements, as well as microbodies. Total quantity of substances solved in water, except the gases, determine its mineralization. Mineralization of ground waters and formation of chemical composition depends on to basic factors: conditions of their origin, interaction with mineral rocks, through which water passes and water exchange conditions. In a number of cases washout of solvable minerals and enrichment of ground waters occur by more widespread anions HCO^- , SO_4^{2-} , Cl^- and cations Ca^{2+} , Mg^{2+} , Na^+ . By their ratio ground waters basic properties are determined – alkalinity, degree of mineralization, hardness.

Precipitations and especially springtime snowmelt runoff serve as the plateau ground waters source. In that period of year occurs drastic rise of ground waters and over humidification of the aeration belt. one of ground waters significant sources is filtration water of irrigation network in vegetation period.

Monitoring of ground water realization level and hydrochemical regime has shown that land amelioration and good condition of environment depend on location of ground waters yearly and of many years levels, and first of all in vegetation period when not correct irrigation drastically raises ground waters level, and chemical fertilizing raises waters mineralization.

Mineralization of ground waters and their level regime influence on salt water solution in the land, and the latter in its turn influence on agricultural cultures yield.

Reclamation condition of landscape including Shirak plateau is directly conditioned by the above mentioned processes which characterize soil and hydrogeological conditions (land and ground water physical and chemical conditions, possibilities of usage) of the given region.

From this it necessitates investigation of the land salinity, mineralization of ground water and irrigation water which will enable to draw up balance of saltwater system “irrigation water, aeration zone water, ground water, drainage water” and determine its nonclosure degree. In other words it will be possible to avoid secondary salination, implement improvement reclamation condition of the plateau irrigated land, rise of cultural plants yield [2, 3].

To evaluate reclamation condition of Shirak plateau land and in case of necessity to implement improvement carrying out the following investigations:

- To study mineralization portions of the plateau ground water according to typical regions and deepness, found out their expansion boundaries and yearly oscillation dynamics,
- To evaluate ground and irrigation waters applicability under international standards,
- To calculate irrigated land saltwater balance of system “irrigation water, aeration zone water, ground water, drainage water”,
- To characterize components of saltwater balance according to the significance and their fluctuation boundaries for soil and hydrogeological various typical conditions of the plateau.
- To determine the saltwater nonclosure degree according to typical regions,
- To evaluate risks of soils secondary salination due to ground and irrigation water mineralization,
- To find out reasons of of cultural plants yield decrease and portions,
- To develop a possible version of a mathematical model for solving irrigated land soils and hydrogeological conditions improvement problem.

Water resources are formed by surface runoff and subsurface water which is replenished by precipitation and meltwater.

Overland flow is far weak due to high porosity of the area, and river network density is small oppositely to southwest. The Akhurian River flows trough Shirak land and finally empties into the Araks River.

Shirak plateau as well as the entire area is quite rich by subsurface water which are formed at the expense of infiltrated in volcanic mountain shield water. Shirak (Gyumri) artesian basin is mostly known [1]. For irrigation purposes Akhurian artesian basin (1400 to 1500m) which is fed by infiltrated into subsoil water of Aragats volcanic mountain shield plays an important role.

Akhurian river basin ground water is characterized by 1g/l general mineralization, 10 to 12°C temperature and 7 mg_{eq}/l gwnwral hardness. For Gyumri narrow gully lake-river complex east part typical are 0.6 to 0.85g/l mineralization (hydrocarbonate or sulfite), 9.8 to 10.5°C temperature, 7.6 to 7.8pH value. High qualitative indices of mineralization are characterized Verin Akhurian narrow gullies pressure fresh water of water-bearing horizons – 0.08 to 0.24 g/l general mineralization, and that of ground water – 0.36 to 0.42g/l. From Zuigaghbiur and Vardaghbiur depressions 240 to 250m depths eastern water spouts over 8m height. Mineral water spouts from 3 to 12m from the earth surface. In Akhurian River basin subsurface fresh water (0.08 to 0.30g/l) of different mineralization is widespread.

In western parts of Gyumri city mineralization of subsurface water varies around 1 and more g/l limits:

- 1.5 to 2.0g/l (sulfite ion prevails up to 0.9g/l)
- 2.0 to 3.0g/l sulfite and chloride ions prevail)
- 3.0g/l and more (sulfite and aluminum prevail).

To the south and south-west from Gyumri city quantity of fluorine in ground water ranges from 1.5 to 1.9g/l/

The regime of subsurface waters are classified into three types [1]:

- Natural (changes of the level, temperature and chemical composition of ground waters are interrelated with natural factors)
- Man-made affected ((is typical for Giumry and Ashotsk narrow gullies when irrigation season starts water temperature and chemical composition are changed)
- Natural affected (is typical for west part of Giumry narrow gullies , especially in the region where mineral waters are widely spread.

Surface and subsurface waters are in indirect hydraulic interconnection, and discharge occurs in the Akhurian river and its tributaries, in certain areas in the form of springs and marshes.

Hydrogeological subdivisions estimate subsurface water protectability degree by a sum of numbers taking into account three basic indices [1]:

- Depth of ground water location
- Mechanical composition of aeration zone soils
- Thickness of weak permeable rocks of the aeration zone (50 to over 250m according to boreholes data)

For agricultural irrigated land hydroeconomic balance plays an important role, which encompasses three important points:

- Evaluation of natural water resources
- revelation of usable and demanded water volumes
- estimation of flow regulation and water resources transfer from place to place.

It follows from the above mentioned that for improvement of the Shirak plateau and why not other irrigated land of the province the following problems need to be solved:

- regulation of ground water location according to cultural plants different groups in terms of their roots length
- measures designed to lessen ground water mineralization
- regulation of salt accumulation process in active layers of soil
- prevention of natural and man-made erosions
- correct and in-time carrying out agglomeration and land treatment
- measures designed to fight against natural water contamination.

To successfully solve the above problems overhumid landscapes data [2-6] of many years investigations (1960 to 2010) can lead to positive results for lands similar to Shirak province in the process of their reclamation.

Conclusions

To improve Shirak plateau soils reclamation condition first of all it is necessary to study both the location depth and borders of ground waters mineralization fluctuations, to reveal processes occurring in the soil active layer of the region.

To organize agricultural production it is necessary to study altimetry, steepness of surfaces, mountainsides positions, horizontal and vertical ruggedness.

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**ՇԻՐԱԿԻ ՍԱՐԱՀԱՐԹԻ ՀՈՂԱՋՐԱԵՐԿՐԱԲԱՆԱԿԱՆ
ՊԱՅՄԱՆՆԵՐԸ ԵՎ ԲԱՐԵԼԱՎՄԱՆ ԽՆԴԻՐՆԵՐԸ**

Ա.Ն. Երոյան, Գ.Շ. Հովսեփյան, Ա.Շ. Նուրիջանյան, Ա.Ս. Մկրտչյան

Ակադեմիկոս Ի.Վ. Եղիազարովի անվան ջրային հիմնահարցերի և հիդրոլոգիայի ինստիտուտ

Հայաստանը լեռնային սակավահող և սակավաջուր երկիր է, ուր միջլեռնային հովիտները զբաղեցնում են տարածքի ընդամենը 10%-ը: Համեմատաբար մեծ լեռնային հովիտներ են հանդիսանում Արարատյան հարթավայրը, Շիրակի սարահարթը, Մասրիկի հարթավայրը և Փամբակ գետի միջին հոսանքի

հովիտը: Այս տարածքներում են գտնվում հանրապետության ոռոգելի հողերի 39%-ը և այստեղ էլ առկա են գրունտային ջրերի բարձր մակարդակների, աերացիայի գոտու գերխոնավացման խնդիրները:

Շիրակի սարահարթի, ինչպես նաև մարզի մյուս ոռոգելի հողատարածքների համար առաջնահերթ անհրաժեշտություն է գրունտային ջրերի թե տեղադիրքերի խորության, և թե հանքայնացման փաստացի վիճակի վերաբերյալ մշտական հետազոտությունների իրականացումը: Խիստ կարևոր է նաև հողերի մելիորատիվ վիճակի, բերրիության բարձրացման և պահպանման նպատակով մի շարք խնդիրների ճիշտ լուծումների պատասխանները:

Բանալի բառեր. սարահարթ, արտեզյան, ստորգետնյա, գրունտային ջրեր, աղակալվածություն, հողերի բերրիություն, մելիորատիվ վիճակ

ПОЧВЕННОГИДРОГЕОЛОГИЧЕСКИЕ УСЛОВИЯ И ЗАДАЧИ УЛУЧШЕНИЯ ШИРАКСКОГО ПЛАТО

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Армения – горная малоземельная и маловодная страна, где среднегорные долины занимают всего 10% от общей территории. Сравнительно большие горные долины – Араратская равнина, Ширакское плато, Масрикская равнина и долина среднетечения реки Памбак. На этих территориях находятся 39% орошаемых земель республики и здесь же высокий уровень грунтовых вод, задачи переувлажнения зоны аэрации.

Для Ширакского плато, как и остальных орошаемых земель области, первоочередная необходимость осуществление постоянных исследований по состоянию глубины залегания грунтовых вод и их фактических минерализаций. Крайне важно решения ряда задач с целью повышения мелиоративного состояния земель, улучшения и сохранения их плодородия.

Ключевые слова: плато, артезианские, подземные, грунтовые воды, засоленность, плодородные земли, мелиоративное состояние.