https://doi.org/10.29013/AJT-23-1.2-24-28

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ON THE POSSIBILITY OF ASSESSING ENVIRONMENTAL RISKS FROM SOIL SALINIZATION IN UZBEKISTAN

Abstract. The problem of salinization and secondary salinization of soils in Uzbekistan on the example of Syrdarya province is considered in the article. The task of ecological risks assessment from primary and secondary salinization is put.

Keywords: salinization, ecological risk, assessment, identification, analysis.

Introduction

The problem of land salinization is widespread in Uzbekistan. One of the largest areas of irrigated agriculture in Uzbekistan is Golodnaya steppe – the sum of areas suitable for irrigation here is more than 800 thousand hectares. Natural salinity of Hungry Steppe soils before active development of irrigation was well enough studied by the mid-20th century. Hungry Steppe before irrigation was characterized by predominance of automorphous soils, which were referred to saline or potentially saline. In hydromorphic soils, the main natural process before irrigation was the process of modern salinization [1; 2].

Secondary salinization control was carried out with alfalfa and other crops at the beginning of XX century. However, the positive effect was not achieved.

In 1964 a government decree on improvement of meliorative condition of irrigated lands on the basis of drainage construction and leaching irrigation regime with intensity 20–30% of net irrigation norm was adopted [2].

However, this approach has led to serious side effects: water withdrawal from rivers for irrigation has increased by 1.7–1.9 times. Drainage water discharge into rivers by the end of the twentieth century increased river water salinity, which also complicated the situation.

At present, the area of saline, irrigated soils in Hungry Steppe remains high and even increases. This is confirmed by the data on salinization of irrigated lands of Syr-Darya province obtained in the first half of the XXI century (Table 1).

It is possible to conclude from table data that significant part of saline soils passes from category of slightly saline soils to category of medium and strongly saline soils.

This state of affairs leads to a number of problems in different branches of national economy. Possible negative consequences from salinization can be as-

sessed with the help of risk theory. Risks from soil salinization according to individual criteria have been evaluated by some authors [4; 5; 6], but a comprehensive consideration of risks from the problem of salinization, especially secondary soil salinization, has not been carried out so far.

Table 1.– Dynamics of salinization of irrigated lands in Syr-Darya province [3]

Year	Irrigated area, ha	Non-saline area, ha	Slightly saline, ha	Medium saline, ha	Strongly saline, ha
2012	286988	5050	232066	45790	4082
2013	286494	7675	224763	50011	4045
2014	286494	7059	223727	50222	5486
2015	287838	7073	230238	45955	4572
2016	287462	7305	222841	51765	5551
2020	286312	10333	202149	64091	9739
2021	287470	10058	204890	63542	8980

The aim of this article is an attempt to systematize the risks arising from secondary soil salinization, for the conditions of Syrdarya region of Uzbekistan.

Materials and methods

Syrdarya province of the Republic of Uzbekistan was chosen as the territory of the study, most of the territory of which is occupied by the so-called Hungry Steppe, the condition of which was considered above.

Elements of the risk theory were chosen as methods of research [7]. It is known that in carrying out any activity and making management decisions, risks inevitably arise. If there is no possibility to avoid risk completely, it is usually possible to reduce risk to acceptable values, including at water management impact on natural environment. At hydromeliorative impact economic and social risks can be considered as a consequence of environmental risk [8].

At present, there is no acceptable methodology for assessing the risk of reclamation activities. Works in the direction of creating such a methodology are carried out by a number of authors [7; 8].

The analysis of environmental risks is based on the following model [9]:

Block 1: Identification of environmental risks: identification of environmental risks for a given process.

Block 2: Environmental risk assessment: a) Qualitative and quantitative analysis of risk factors, b) Assessment of environmental and human hazards

Block 3: Environmental risk monitoring: monitoring environmental risks for a given process

Block 4: Environmental risk management: a) Choosing the risk management methods for a given process; b) Implementing environmental risk management measures; c) Monitoring the effectiveness of risk management; d) Adjusting risk management measures.

Results and discussion

Let's make an assessment of geo-ecological risks at various hydromeliorative works processes in the Hungry Steppe (by the example of Syr-Darya region). Consideration of risks will be made for existing method of irrigation with creation of hydromorphous regime

1. Identification of ecological risks

In this case the reason of ecologically unfavorable region is secondary salinization.

2. Qualitative and quantitative analysis of risk factors.

Let us consider the consequences caused by secondary salinization of soils (Fig. 1)

a) Qualitative analysis

b) quantitative analysis

1) Increased irrigation water consumption:

- In Kazakhstan and Central Asia, 50–60 million hectares of land suitable for irrigation. There are enough water resources for irrigation of 8–10 million hectares;

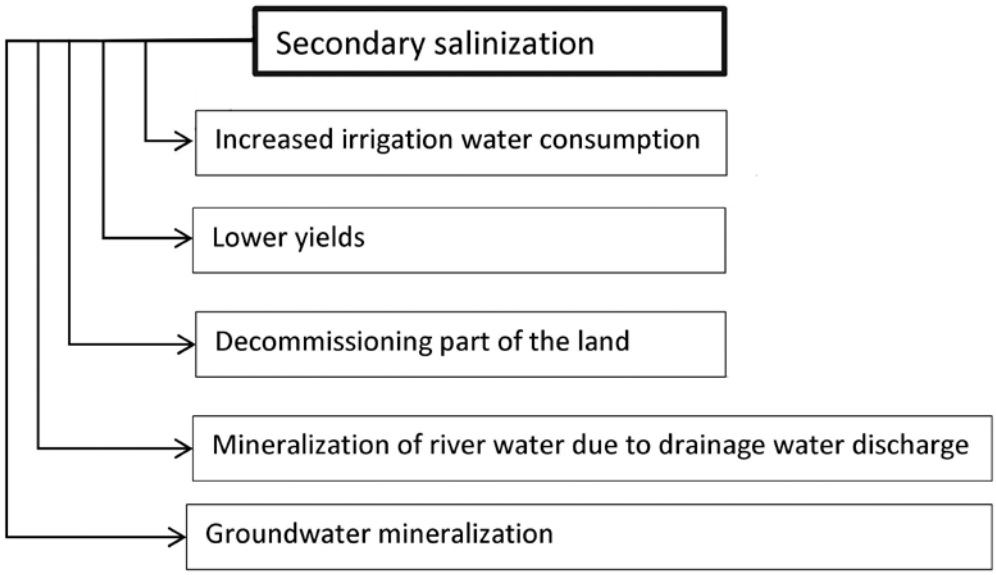

Figure 1. Risks of secondary salinization

- lWatering norms of about 20 thousand m^3/ha
- 80% of irrigation water is spent on evaporation, and salts remain in the soil [10].

2) Yield reducing:

- with low salinity at 0 … 33%
- with an average salinity of 50%
- with strong salinity at 67 … 83%
- with very strong salinity at 100% [10].

3) Decommissioning of part of the land

- The number of highly saline soils in the Syrdarya region;
  2020–9739 ha
  2021–980 ha [3, 11];
- The area under raw cotton crops decreased from 2013 to 2016 in the Syrdarya region from 235185 ha to 191188 ha [3].

4) Mineralization of rivers:

- At the exit from the mountainous territory, the mineralization of river water does not exceed 0.3 … 0.4% and has a bicarbonate character. As it mixes with return waters from irrigated territories and groundwater drained by rivers, the mineralization of river water reaches 1 … 2 g/l, gradually acquiring a sulfate-chloride character due to the discharge of drainage effluents from the overlying irrigated territories. The mineralization of river waters has increased 3 … 8 times over the past 50 years [10];
- Huge norms of fertilizers (up to 600 kg/ha) and pesticides after washing the soils strongly mineralize the waters and saturate them with toxic substances. These waters are discharged in large quantities into the Syr Darya and Amu Darya and are reused downstream for irrigation;

5) Mineralization of groundwater:

- Irrigation channels create sources of concentrated water loss in groundwater, thereby forming their local pressure;
- lGroundwater (with an unexplored degree of mineralization) can be used as an additional source of irrigation water [3].

In 11 key areas of the Syrdarya and Jizzakh regions [12], the groundwater level at a depth of 0.8 … 2.5 m, i.e. much higher than the "critical" level of the GW. Mineralization is weak (3.86 g/l), average 8–10 g/l, strong 10–25 g/l

3. Assessment of environmental hazards to the environment and humans

- Irrigation water consumption – reduction of fresh water reserves – water crisis;

- Secondary anthropogenic salinization of irrigated lands is a process leading to disruption of the global biosphere mechanism [10].
- For humans (ecological and social risks):
- Decrease in yield – shortage of agricultural products [13];
- Decommissioning of part of the land is a social danger of unemployment of the population;
- Additional expenses incurred to minimize salinization, as well as to repair buildings and infrastructure elements affected by salinization.

4. Monitoring of environmental risks in this process

- Measurements of soil salinity;
- Measurement of the level of GW (measurement of the level of GW during the growing season, determination of the mineralization of GW);
- Control of GW effluents.

5. Environmental risk management

- The creation and maintenance of an optimal water-salt regime of the soil of the Hungry Steppe is achieved only with the implementation of a complex of reclamation measures, the most important of which are:
- Drainage;
- Layout;
- Flushing;
- Differentiated regime and technique of irrigation of agricultural crops [14];
- For difficult-to-reclaim gypsum-bearing soils, special complex agro-reclamation systems are required for large water consumption for washing >20 thousand m^3/ha for a period of improvement of 6–8 years.

Conclusion. The preliminary analysis shows that there are significant risks associated with soil salinization in the Syrdarya region.

The measures used require a long time and large capital investments. In addition, all these activities can also be sources of environmental and geoecological risks to be assessed.

Therefore, the tasks of further research are:

1. carrying out an updated assessment of the probability of occurrence of environmental and socio-economic risks from salinization;

2. determination of the extent of possible damage from secondary salinization to the environment and various spheres of human activity;

3. identification of risks and damage during the implementation of measures to reduce salinization (including the use of drip irrigation).

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