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Some Principles of Accounting for Social Risks in Reclamation and Water Management

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ABSTRACT: The possibilities of social risks arising in agriculture, including reclamation and water management, are discussed. A forecast assessment of the catastrophic risk of accidents on reservoir-based reclamation systems in Georgia is provided. A number of measures are proposed to protect the health and lives of the population, and to protect the infrastructure in areas at risk of possible technological disasters.

KEYWORDS: agriculture, risk classification, socio-economic risks, expert assessment of the reliability, protection of economic infrastructure.

INTRODUCTION

It is known that the foundation of social development in human society primarily lies in its activity, aimed at creating material, cultural, spiritual, and other values. However, this creative activity often faces the problem of socio-economic risk, which represents the potential likelihood of negative impacts on the results of public activities and, in extreme cases, on the very existence of society. It should be noted that the emergence of social risks can be associated with a wide range of events: from natural disasters and climate change to industrial accidents and environmental pollution. These changes often affect human health, biodiversity, ecosystems, and economic systems in general. In general, socio-economic risks can be divided into risks related to industrial activity, including technological disasters, emissions of pollutants, accidents in manufacturing; risks arising in agriculture due to climate change, violation of technology in crop cultivation, risks of accidents and disasters in reclamation reservoir systems, risks of negative changes in plant and animal biology, environmental ecology, and risks of other adverse consequences.

MAIN PART

Let us consider the possibilities of the occurrence and consequences of the realization of social risks in such an important area of human activity as agriculture. It should be noted that practically any economic activity is exposed to risks of both subjective and objective nature. As for agriculture, its uniqueness lies primarily in the fact that, unlike other production sectors, it operates based on both human labor and natural living organisms: soil, crops, and animals. The use of living organisms requires special demands on the climatic conditions of the production territory, namely, requirements for heat, sunlight, and moisture. Today, some researchers identify more than 250 types of agricultural risks, and the number of considered risks continues to grow with the development of society. Accordingly, the number of existing classifications is also increasing. Therefore, there is currently no consensus on the classification of economic risks and specialized classifications that take into account the peculiarities of agricultural production. In our opinion, the most acceptable classification of risks is carried out by the nature of their occurrence, as well as by the sources of financing organizational and technological production activities. Accordingly, depending on the source of funding, risks can be technical and legal, state, managerial, market, communication (managerial), and other types of risks.

Since the agricultural sector is one of the most sensitive sectors of the economy, the economic activities of agricultural enterprises are always at risk. Here, risk is understood as the possibility of economic losses for farming entities due to the impact of natural, climatic, or anthropogenic factors on the normal functioning of the production process. It should be noted that the realization of risks in agricultural production is usually the primary cause of socio-economic crises. For example, a shortage of agricultural products caused by adverse climatic or other production conditions leads to food shortages and, consequently, to the risk of worsening the socio-economic situation in the country. In this regard, an important condition for minimizing such risks is land reclamation,

which, through irrigation of agricultural land, ensures stable and high crop yields.

One of the most important elements of irrigation complexes are reservoirs, which provide accumulation, increase, and most effective use of water resources. However, reservoirs, along with significant positive effects, also carry the threat of catastrophic destruction, leading to human casualties, the loss of agricultural land, and damage to housing and transport infrastructure [1,5,6,7]. For example, the disaster at the Saint Francis Dam (California), the destruction of the Malpasset arch dam (7 kilometers north of the city of Fréjus in southern France), the disaster at the Vaiont Dam (one of the highest dams in the world at 262 meters) in the Italian Alps, the destruction of the Baiyanzao Dam in China, and the technological disaster at the Sayano-Shushenskaya Hydroelectric Power Station (Russian Federation) between the Krasnoyarsk Territory and Khakassia claimed thousands of lives, causing irreparable damage to both the production infrastructure and the environment.

It should be noted that accidents on dams and embankments have catastrophic consequences not only on large water management systems but also often on smaller facilities. For example, the disaster on May 14, 1980, at the dam in the village of Tkhneti (Georgia), where due to heavy rains, water overflowed the relatively small 12-meter-high earthen dam, causing the deaths of seven people and significant damage to the city infrastructure [4].

The list of accidents and disasters at reservoirs worldwide can go on, but from the examples provided, it is clear that reservoirs, by their nature, are objects of increased danger and their operation is associated with the risk of catastrophic consequences: loss of life, destruction, and various economic losses. Previously, the authors calculated the risks of accidents and disasters at operating reservoirs in Georgia. The main factors (causes) of accidents and disasters on reservoirs were considered to be: the condition of the reservoir bed and its filling method, the hypsometric and relief characteristics of the area, the seismicity of the area, the material of the dam, and atmospheric precipitation (annual and daily rainfall maxima). The values of expert risk assessments for accidents and disasters at the operating reservoir systems of Georgia were established on the following scale: the factor does not affect the occurrence of an accident – 1; affects slightly – 2; affects weakly – 3; affects noticeably – 4; affects strongly – 5. The total normalized risk of accidents and disasters (D) is determined by the formula:

$$D = 0.2d1 + 0.2d2 + 0.2d3 + 0.2d4 + 0.2d5$$

Expert evaluation showed that the highest total sensitivity was observed in reservoirs where the hypsometric, relief, and seismic characteristics of the area, as well as the construction material of the dam, reached their maximum [2,3].

Comparing the calculated risk of accidents and disasters with the actual causes of global catastrophes showed that, in addition to the listed factors, landslides of soil and rock in the reservoir bed and dam foundation, caused by extreme atmospheric precipitation, also significantly affect the occurrence of accidents. Moreover, errors in design, construction, and operation are also significant. An analysis of the technical operation of dams showed that when determining the economic efficiency of their construction, it is essential to take into account the forecasted amount of damage caused by the accidental destruction of the reservoir. The ecological-economic damage in agriculture and forestry is primarily composed of losses of agricultural and forest lands, livestock deaths, destruction of production buildings and structures, agricultural machinery and equipment, residential buildings, etc., which makes it necessary to implement some preventive measures, including the resettlement of people from potential flood zones, improving the reliability and quality of design, construction, and operation of reclamation facilities.

CONCLUSIONS

The dynamic development of the country and the reduction of the likelihood of socio-economic crises are largely associated with reclamation and water management, which determine the effectiveness of sectors such as agriculture, energy, drinking and industrial water supply, and tourism. In turn, the development of reclamation and water management is practically impossible without the creation of reservoir systems that allow for the most effective use and increase of water resources.

The analysis of accidents and disasters at reservoirs worldwide has shown that reservoirs, by their nature, are objects of increased danger, and their operation is associated with the risk of catastrophic events: loss of life, destruction, and various social and economic losses. In this regard, an analysis of the existing reservoir systems of Georgia, most of which are located in mountainous and foothill areas of the country, is of interest.

The expert assessment of natural conditions has made it possible to forecast the likelihood of accidents and disasters at the operating reservoirs in Georgia. By normalizing the expert data through linear transformation, forecast values for accident rates at the country's reservoir systems have been established.

An analysis of the sensitivity of dams in Georgia's reservoir systems has led to the proposal of several priority measures, including preventing the consequences of accidents and disasters. These measures primarily involve resettling the population from possible flood zones, ensuring proper technical operation of water management objects, and regularly conducting their maintenance and repairs.

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