Features of the assessment of environmental damage from fires in a forest

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Abstract. Within the framework of this material, special attention is paid to determining the size of the resulting environmental damage in connection with fires in the territory of the Russian Federation. To create a complete and more qualitative picture of the scale of damage, a special comprehensive assessment is used, which includes damage to water and land resources, as well as to the resources and potential of the animal and plant world. Through the use of such an integrated approach, it becomes possible to determine the overall level of costs for measures to reduce and prevent further increases in damage from forest fires.

1. General information
On the territory of the Russian Federation, the area of forests is more than 1,170 million hectares, which is one third of the total number of forests on the entire earth's surface. It should be noted that 75% of these forests are located in the eastern part of the state. The richest region in terms of forests is Siberia. This area is characterized by dead wood, litter, windbreak and windfall. These factors are contributing to the subsequent spread of fires.

Paradoxically, but it is the person who is the main culprit in the outbreak of forest fires, his careless behavior in the forest, namely:

- not extinguished fire (matches, cigarettes, the consequences of leisure in nature);
- annual agricultural burns;
- non-observance of fire safety rules during logging;
- deliberate arson.

The spread of fire in the first two cases occurs quickly in strong winds and dry weather. Therefore, fires are most likely to occur during the dry summer months. In winter and autumn, fires occur less frequently and do not require huge efforts to eliminate them [1].
Thus, the main cause of a fire is anthropogenic impact, which is 72%, the smallest share is agricultural fires and other causes.

Taiga is the most vulnerable fire hazardous territory of the country, it accounts for the largest number of fires. The emergence of strong fires is associated with the remoteness of settlements, difficult access roads. The longer the fire prevention measures are not applied, the stronger the fire. Fires in Siberia are considered large-scale, their elimination is possible only with the use of aviation [2].

It is worth noting that environmental damage also includes economic components and estimates of economic losses from forest fires. In connection with such a problem, the creation of a specific environmental and economic assessment is the most important issue for modern science. This assessment is especially important in the context of forest fires. It should be noted that at the moment there is no single approach to the definition, which makes the procedure for obtaining an objective assessment extremely difficult.

According to official statistics collected by the state, the total scale of damage from forest fires in 2018 decreased by 8.3 billion rubles and now amounts to 16.9 billion rubles [3]. At the same time, the damage from forest fires in 2019 is estimated at 15 billion rubles. Based on this, it can be concluded that the total number of forest fires is gradually decreasing, which makes it possible to reduce the overall economic damage. However, according to statistics, in 2018, fires affected 3.2 million hectares due to 9,900 fires. In 2019, the total number of fires increased to 14 thousand. Almost all forest fires occur in the Siberian Federal District [2]. Among the most common reasons for the formation of a fire, one can single out careless handling of fire, as well as weather conditions.

The main problem is that all forest fires cause irreparable harm to the environment, which also negatively affects human life. At the same time, it is extremely difficult to assess the potential damage from a fire, since it affects a huge number of sectors of the economy, and the creation of a comprehensive assessment involves the collection of a large number of factors and tools. At the same time, damage from fires can manifest itself even after years, which also only complicates the approaches to assessment.

Thus, it becomes necessary to conduct a thorough study of all indicators of the state of the environment and its resources. To this end, it is required to develop modern and more accurate methods and tools to create a specific estimate of economic damage due to environmental pollution.
It should be remembered that the main need for damage calculations is formed based on the need to determine the cost effectiveness to prevent or completely neutralize the negative impact. In such a case, efficiency is the most economical way to compensate for all existing fire losses.

All of the above reasons are factors that form the purpose of this study, the essence of which is to generalize all available approaches to creating an environmental and economic assessment of damage from forest fires.

Achieving this goal of work requires solving the following list of tasks:

- Determination of the main factors of the environmental, social and economic environment that suffered damage from fires;
- Study of existing methods for calculating costs and choosing the most optimal ones;
- Exploring the advantages and disadvantages of assessment techniques.

2. Main part

The impact of fire extends not only to the forest, but also destroys and damages water bodies, land resources, representatives of flora and fauna, which are also ecological natural components.

To conduct an ecological and economic assessment of environmental damage, it is necessary, first of all, to determine those functions of the forest and other natural components that receive qualitative or quantitative damage as a result of a fire.

Unfortunately, the Forest Code of the Russian Federation [5] does not reveal the ecological function of forests, since the influence of the forest on the flora and fauna, both inside and outside the forest, is not indicated. Forests perform several functions that provide life support for the ecosystem: ecological, economic, cultural and recreational.

The ecological function of a forest is its beneficial effect on the environment. The forest area protects the environment and soil, regulates the climate, participates in the regulation of water resources, and has a sanitary and health-improving effect on the environment [6].

The forest is a source of timber and various products of mass consumption, which determines its economic function.

The cultural and recreational function of forests is as follows. The forest area serves as a source of oxygen and promotes health, and also helps people develop their knowledge of nature.

By releasing oxygen, absorbing dust, the forest realizes its sanitary and hygienic functions.

Currently, a number of methods have been developed for calculating the complex ecological and economic damage from the impact of fire on a forest.

One of the modern methods is the "Methodology for assessing the economic efficiency of forest reproduction measures" [7], developed by the Far Eastern Research Institute of Forestry. The proposed methodology takes into account the loss of wood in forested areas.

To assess the economic efficiency of reproduction according to this criterion, two indicators are proposed:

- the ratio of the increase in the cadastral value of the area of forest land from measures to create forest crops, promote natural reforestation and thinning of young growth in monetary terms to the cost of their implementation;
- the ratio of the cadastral value of forest land after carrying out the relevant work to the costs incurred. The problem of using this criterion lies in the absence of a methodology and procedure for assessing the cadastral value of forest lands, provided for by the current Forest Code of the Russian Federation. Before their development and approval, a methodology for assessing the cadastral value of forests is proposed, which is based on the long-term developments of FBU "DalNIILKh", other research and regulatory materials.

The weak point in the application of this technique is the lack of accounting for the effect of fire on other components of the environment, in particular the animal and plant components, and the estimation of the amount of emissions of carbon monoxide and dioxide.

To take into account the benefits and costs of the presence and operation of forests, taking into account the time factor, the method of discounting cash flows is used as one of the methods of the
income approach. This is one of the basic approaches in economics, based on the concept of time as the main aspect in assessing the market value of forest areas. Making accurate calculations is impossible without taking into account the distribution of costs and benefits over time. Obviously, this method of discounting cash flows works by discounting costs and benefits. The result of growing new forests (young growth) will be obtained in the future, then its value can be determined, taking into account a number of factors: the annual growth of wood, the cost of money in time, as well as the period for obtaining the maximum supply of wood. It turns out that the cost of a forest area depends on opposite factors:

- an increase in value due to the natural growth of the forest,
- a decrease in value due to a decrease in the value of money over time in the course of a discounting operation.

Therefore, due to the long period of reproduction of forests, and the high sensitivity of investments to changes in the discount rate, the value of the forest or its profitability can be equal to zero. The Forestry Code [3] sets the discount rate at 2%. A positive moment when using land in forestry is an almost unlimited service life with proper care. In this case, the cumulative effect of long-term use must be taken into account.

The discounting method also “suffers” by the lack of accounting for the loss of other natural components (land, water, living organisms) when forests are damaged by fire.

There are other approaches and methods for accounting for damage, such as the reproduction method (measures losses from damage by calculating the cost of reproduction), based on the cost approach; method of hedonic pricing, based on a comparative approach, when the value of the subject of assessment is justified by comparison with similar objects [5].

3. Conclusions

Every year, like an epidemic, forest fires spread over the vast territory of the Russian Federation - this problem needs an effective solution. Forest fires, as a factor of destabilization of the ecological and economic environment, entail many negative consequences: they cause irreparable damage to settlements, their real estate, life and health of people, alter vegetation, biocenosis and soil composition, and the overall ecological situation is deteriorating. All this requires an immediate and effective solution to prevent this phenomenon. This difficult situation worries the population of all countries of the world, including Russians.

While wildfires are costly, they also contribute to environmental degradation and harm to humans [8].

The consequences of forest fires can be divided into two groups:
1) natural:
   - destruction of ecosystem vegetation and fauna representatives;
   - modification and desertification of the soil;
   - deterioration of the state of water bodies caught in the disaster zone.
2) for the population:
   - emission of harmful gases into the atmosphere;
   - destruction of forest plots where timber harvesting was planned;
   - causing significant damage or complete destruction by fire of residential buildings located in the immediate vicinity of forests;
   - destruction of peat stocks;
   - deterioration of air quality as a result of smoke pollution in areas adjacent to combustion centers.

At the moment, there is an extremely active consumption of various categories of environmental goods, which receive significant damage. All this damage must be carefully calculated and compensated by the resource consumers. At the moment, there is a wide number of assessment tools, and the choice of specific ones depends on the responsible persons making such decisions, as well as on their
willingness to spend their own material resources to use methods for detecting and extinguishing fires, as well as eliminating the consequences of such disasters [9].

Among the main disadvantages of the techniques that were mentioned in the framework of this material, the following should be noted:

- Lack of a unified approach to assessing economic, social and environmental losses;
- Use of a loss calculation that is based on averaged market data from the Russian Federation, which distorts the results.

It should be noted that at the moment there is a sufficient number of regulatory documents that describe in detail the methodology for determining the damage arising from the negative impact on the environment, including forest fires [10]. The entire estimate of losses should be based on the amount of payment per unit volume of wood, as well as on the basis of the cost of all costs required to produce a certain product.

Nevertheless, the continuation of the development of various documents is required, which would make it possible to organize a unified approach to assessing the damage caused to the environment. To this end, it is necessary to develop a better-quality legislative framework that will take into account all the specifics of the industry.

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