

## THE ADVANTAGES OF APPLYING REMOTE SENSING FOR REGULATING NATURE PROTECTION ACTIVITIES

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### ABSTRACT

The purpose of the study is to identify whether remote sensing has any benefits for controlling economic activity and protection, especially in forest areas.

The practical value of research is that to substantiate the recommendations for applying remote sensing to increase efficiency of nature protection and economic activities in forests areas (using international experience, including Russia and Kazakhstan).

The results show that remote sensing may help to collect the required data which has the significance for developing the reaction strategy to the external threats and for minimising their impact on forestry.

**Keywords:** *remote sensing, forestry, nature protection activities, international experience*

### INTRODUCTION

Flame and fires are one of the main threats for forests, and they play a huge role in the past, present and future in the self-regulation of the ecosystem of our planet [1]. Monitoring of dynamic and territorial data about fires is fundamental in understanding environmental processes and the impact of anthropogenic activities in different areas of economic activity, including arable regions [2]. Scorched areas of agricultural land can go out of economic use if disturbances in the vegetation-water balance occur [3]. Also we need to know that forestry play a huge role in maintaining the water balance of the area [4]. In case of large fires, huge vegetative arrays can be disappeared, which may affect on disturbances of the water balance of the area, which can lead to a decrease in the fertility of nearby agricultural lands [5].

The analysis shows that fires can be divided into three categories: 1) anthropogenic origin; 2) natural origin; 3) improper planning of economic activities.

Incorrect planning of economic activities can lead to fires not only in the territories of forestry enterprises, but also in other adjacent territories.

Fires caused by anthropogenic activities are destructively reflected in ecosystems [6]:

- Carelessness at production facilities.
- Errors and miscalculations at industrial complexes.
- Non-compliance with safety rules in agricultural enterprises.
- Population's misunderstanding about threats of fire.
- Poor construction of buildings, which lead to a fire as a result of a natural disaster.
- Wrong using and storage of explosive substances at production facilities.
- And so on.

Also fires can be of natural origin and they took place before the appearance of man, which is proved by paleoclimatic and paleovegetation studies [7], [8].

Ignition often occurs during dry seasons, and in areas where combustible natural minerals are located close to the soil [9]. Thunderstorm is also the most frequent source of ignition on the large areas [10].

Low burning intensity after a thunderstorm or other natural disasters plays an important role in the cycle of useful and nutrients for vegetation, compliance with the diversity of the plant world and the structure of the vegetative cover of the soil [11].

However it should be remind that human economic activities, as well as the economic activity of enterprises in particular, have become the main source of increase in the number of precedents of fire: from the end of the 20th century, anthropogenic activity began to put more pressure on the balance of the planet's ecosystem, mainly having a negative impact [12].

A high frequency of fires or even the number of seasonal precedents of fire in a certain forest area has a negative effect on the following components [13]:

- Biosphere.
- Pedosphere or layer in which processes associated with the formation of soil and soil cover occurs.
- Components of the atmosphere.

## **FOREST AREA AND WILDFIRES**

Humanity is well aware that the forest is the lungs of our planet. The earth's forest resources retain and process carbon dioxide into oxygen. Scientific research shows that there is an excess of CO<sub>2</sub> and a "greenhouse effect", resulting in global warming and climate change on Earth. One of the most important factors affecting the change in the composition of the atmosphere is the decrease in the area of the earth's forests, which is accelerating as global warming develops (table 1). In 2016, the area of forests worldwide was 3995.8 million hectares, which is 117.9 million hectares less than in 1992. In recent decades, forests in Russia and Canada have been the main contributors to improving the earth's atmosphere. Russia remains one of the few countries in the world where the area of forests has not decreased, but has significantly increased. In comparison with Russia, Kazakhstan has insignificant forest areas, which have even decreased somewhat in recent years.

*Table 1. Forest area in the world, Russia and Kazakhstan*

	World	Russia	Kazakhstan
Forest area (million hectares)			
1992	4113.74	809.27	3.4
2016	3995.8	814.89	3.3
Forest area (% of land area)			
1992	31.6	47.7	1.3
2016	30.7	49.8	1.2

*Source: The World Bank*

We have already noted that the area of forests continues to decline worldwide. The loss of forest cover is mainly due to industrial logging, as well as massive fires of a natural nature, especially in the Northern forests. In the world, the largest number of fires and areas covered by forest fires occur in Russia, Canada and the United States, primarily because of the huge forest areas of these countries compared to others (table 2). However, these countries have accumulated important experience in fighting forest fires using remote sensing technologies that can be useful to others, including Kazakhstan.

*Table 2. Forest fires in some countries of the world*

	Russia	Canada	USA
Number of wildfires			
2010	33423	7291	71971
2016	11025	5243	67743
Area of forest land covered by fires, thousands of hectares			
2010	1962.3	3052.5	2396.5
2016	2508.3	1404.7	2229.8

*Source: Federal State Statistic Service of Russian Federation*

Analysis of statistical data shows that about 500 fires occur annually in Kazakhstan with a total area of more than 10 thousand hectares. These fires cause significant damage to the economy, so it is necessary to use effective measures to combat them based on our own developments and international experience.

## **METHODS AND METHODOLOGY**

### **REGIONAL ASPECTS OF FACTOR ANALYSIS**

Many researchers believe that there are at least three main factors of negative impact from fires and fires of varying degrees of complexity that must be taken into account when planning and determining solutions to economic and environmental activities in forests. These factors are: A) the harmful effects of high temperatures during a fire; B) the disruption of vegetation processes; C) the greenhouse effect. All this is also typical for the object of our research Almaty region of the Republic of Kazakhstan.



Research shows that fires have a bad effect on the process and formation of vegetation phases [14], [15]: reduction of nutrients needed for vegetation; decrease in total biomass; in particular, trees and shrubs are affected, which can lead to the disappearance of representatives of the plant and animal worlds that are sensitive to fires, which is bad for forests.

The destructive effect of high temperatures, accompanied by chemical secretions during burning, can: change the chemical characteristics of the soil; violate the natural physical properties of the soil; bring to erosion, loss of useful soil cover; bring some areas in the forests to an unsuitable condition for the living of certain species of animals and plants before carrying out expensive restoration work.

The greenhouse effect from fires negatively affects on the atmosphere and make harm to the environmental situation.

We agree with the opinion of a number of scientists who believe that the drying of swamps and other activities aimed at agricultural needs, which often violates the water balance, which is one of the natural protective mechanisms against fires, can create areas covered with dry grass that are easily combustible in the summer time of Almaty province. However, indirect activity as the creation of infrastructure and industry make a good platform for ignition due to negligence, lack of professionalism, lack of control or after a great cataclysm.

As a result of the fire damage, for the safety of the country and the population, and for economic inactivity, it becomes necessary to monitoring and collect data about the fires as quickly as possible. The remote sensing of forests in fire, is one of the methods of collecting information necessary to develop a strategy for firefighting. We need to remember that each plot of land can have its own characteristics, so the collection of information by sensing before, during and after the fire will allow you to create dynamic models for fighting fires for this area.

Forests can be burnt, especially in dry periods; their deforestation does not solve these problems.

The disappearance of forests creates environmental problems not only for Kazakhstan, but also leaves mark to a global climate change and the disappearance of biological diversity.

Wrong exploitation of forests, deforestation of forests for agricultural, infrastructural and economical needs, and using lands for agricultural activities are some of the strongest sources of greenhouse gas production.

Below is a brief analysis of the factors that can lead to the disappearance of forests, taking into account the realities of the Almaty region of Kazakhstan. It should be borne in mind that economic development, environmental pressures created by population growth, as well as pressures created by institutions and businesses are not the last deforestation factors.

Urbanization is not only one factor of deforestation, but also it cause of the disappearing of the natural habitat for many representatives of flora and fauna. If in 1800 only 2% of the world population lived in urban areas, then in 1900 - already

15% of the global population lives in cities and towns. The process of increasing the number of cities and the population moving there accelerated in the 1950s. In the 1950s, 70% of the world's population lived in rural areas. In 2007, for the first time in the written history of humanity, the population of cities and their agglomerations exceeded the number of people living in rural areas. In 2017, already 54% of the world population lived in cities. As we can see economic growth, migration, and urbanization, many scientists predict further growth in the urban population. The urban population growth and created tremendous pressure on nearby territories. If there are forests in areas adjacent to the cities, then they will most likely be cut down for agricultural purposes, which will feed the urban population. The growth of cities and towns near forests can make deforestation for the following reasons: clearing land for development, deforestation for the creation of industrial and industrial zones.

Another factor of deforestation that is associated with the process of urbanization - the creation of infrastructure in place of forests. The construction of infrastructure, which helps for economic activities in the forest, can also negatively affect for the local flora and fauna. Trade development is one of the strongest factors that make forests disappear. It should also be noted the role of industrial production for international trade, which often lead to the disappearance of forests. Agriculture, focused on mass production and it is also one of the causes of deforestation, which is especially evident in South America and Southeast Asia.

Not only fire has a bad effect on the balance of the forest ecosystem. It is necessary to list other natural disasters that can damage or destroy forests in many regions of the world, including the Almaty region of Kazakhstan. These are floods, earthquakes, droughts, epidemics, and more.

Forest conservation is more effective for reforestation than the creation of shared areas in forests. Monitoring situations of consequences of anthropogenic or natural factors that harm the soil-plant balance of forest biomes, and constant monitoring of the current situation in forests is one of the necessary factors for harmonious economic and environmental development. Sounding is one of the best methods for collecting forest data for a wide range of tasks, from monitoring the current state of flame propagation to identifying the effects of an earthquake or an accident at a local chemical plant near forests.

#### ADVANTAGES OF REMOTE SENSING TECHNOLOGY

The special literature points to the many advantages of remote sensing technology, including: large coverage of the territory, repeated study of the territory, easy data collection at various scales and resolutions, there are no restrictions on the amount of information obtained from a single image, the data can be easily processed and quickly analyzed using a computer, remote sensing does not violate the object or area of interest, data analysis is carried out in the laboratory and this minimizes the duration of field work, sensing is a relatively cheap and constructive method of reconstructing the base map in the absence of detailed data on forest lands, it is easier to detect forest fires that have spread to a large region, which facilitates planning a rescue operation easily and quickly. Figures 1 and 2 shows some possibilities for using modern remote sensing technologies.



*Figure 1 - Typical picture of a forest obtained on the basis of remote sensing technology Source: Open information platforms*

It is necessary to be objective to recognize some disadvantages of remote sensing technology, including: the fact that this is a fairly expensive method of analysis if we consider small areas, sensing requires special training for image analysis, human errors are possible when collecting and analyzing data, the analyzed image may sometimes be disturbed by other phenomena, the collected information may be incomplete and temporary, and more.

In the Almaty province, there are two sensing methods that can be used to collect information on the state of forests: 1) obtaining images through satellite reconnaissance devices allows you to get understanding about mesoscale of the forest biome and the landscape characteristics of the ecosystem; 2) the use of drones, various remote control aircraft, aerial photography tools allows you to get information about the micro topographic characteristics of the areas, especially of the soil and vegetation layer, also to get information about the main representatives of the flora.



*Figure 2 - Space image of a forest fire*

*Source: Open information platforms*

Depending on the situation, the following recommendations are proposed for further strategy and effectiveness of forest biome protection when using sensing in the Almaty region.

1. It is proposed to plant a new forest if there is a complete destruction of the forest biome, for example, when the entire soil vegetation layer is washed away with trees as a result of natural disasters.

2. Prohibition and monitoring of compliance with the ban on any economic activity in the forest, if there was a strong destruction of the forest biome, for example, if many representatives of flora and fauna disappeared as a result of an earthquake and fire.

3. Reclamation of forest land and permission for limited economic activity in the forest, if there is an average destruction of the forest biome, for example, when about half of the forest is cut down for agricultural purposes.

4. If there is a weak destruction of the forest biome, for example, when zoning shows localized fires, it is recommended to impose restrictions on economic activities in the forest until the threat is neutralized.

## **CONCLUSION**

The study showed that remote sensing technologies have both advantages and disadvantages, but it is obvious that they need to be used for monitoring environmental activities, which is especially important for such an economic sector as forestry.



The forest is extremely important for humanity. Unfortunately, long-term analysis has shown negative dynamics of forest area changes in most countries and in the whole world, and one of the main reasons for this phenomenon is forest fires.

Despite the fact that Kazakhstan currently plays a minor role in the world's forestry, it is necessary to change the situation so that over the next 20 years, the area of forests in the country has increased 3 times to about 10 million hectares, and the number of forest fires has been reduced to a minimum.

Kazakhstan should make more active use international experience to fight forest fires based on remote sensing technologies. At the regional level, the country should take into account the impact of various factors in the development of forestry in order to develop effective proposals for the use of remote sensing technologies.

The use of drones for sensing forests has great potential for the Almaty region of the Republic of Kazakhstan: easy transportation, compared to aircraft; optimality in use; cheaper to maintain in working condition; the massive use of drones can become the basis for the emergence of a competitive industry of aircraft in the Almaty region; the development of the industry for the production and maintenance of drones on a global scale can make these devices cheaper and more efficient as global technological progress.

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