Carbon landfills and carbon farms: their impact on the territory of the region

Islam Kudusov*, *Laila* Satueva, and *Raisa* Bankurova

Kadyrov Chechen State University, Grozny, Russia

Abstract. The process of decarbonization in the Russian Federation is being carried out at an accelerated pace. Since the launch of the carbon landfill project in 2021, seven sites have been created, six sites are being created in 2022, and eight more projects are scheduled to open in 2022-2023. In this article, the definition of a carbon landfill and the need for its creation were given. A map of the location of carbon sites on the territory of the Russian Federation, a schedule for the implementation of the carbon project was shown. The prospect of implementing a carbon project in the Voronezh region, the operator of which was the Voronezh State University, is considered in more detail. Plants necessary for planting carbon polygons and carbon farms, as well as ways to dispose of species that are no longer suitable for observation, have been determined. The topic of the need to train personnel to work in the modern realities of the "green" economy and the introduction of new, previously non-existing professions was touched upon. An average of 15 million rubles is allocated from the state budget for the implementation of a carbon landfill. for scientific research and 17–18 million for practical equipment. In addition, Russia is the state with the richest forest fund, which gives it an advantage to become the world leader in carbon dioxide absorption. It is necessary to translate this potential into a monetary equivalent as soon as possible. The action strategy is as follows: calculate the "carbon" balance → sale of cultivated crops → development of the country's economy. Literally increase the economy of the state, sell clean air.

1 Introduction

One of the most important tasks is to increase the reliability of assessments of the components of the carbon cycle in the landscapes of Russia (fig. 1). At present, such estimates are characterized by high uncertainty, primarily due to the acute lack of direct measurements necessary for verification of Earth remote sensing data. To improve the accuracy of the data, it is necessary to complete the work on the state forest inventory (SFI) as soon as possible, improve the methods for estimating the carbon budget by natural systems (primarily forests); development of a network of direct measurements of fluxes of greenhouse gases Fluxnet; improving the quality of scientific expertise of the formed network of carbon polygons. It is necessary to gradually create a representative network of observations covering the main landscape zones (tundra, taiga of various types, mixed

*Corresponding author: Kudusov_95@mail.ru

forests, forest-steppes, steppes, deserts; azonal landscapes, primarily swamps) and various types of landscapes depending on the nature of land use (arable land, pastures, perennial crops, cuttings and abandoned agricultural lands in various stages of succession) [1]. Ultimately, these approaches will make it possible to create a unified National Register of Natural Greenhouse Gas Emissions and Removals (in addition to the existing National Inventory of Anthropogenic Emissions and Removals), which will be used by networks of direct measurements and remote monitoring covering various natural situations. Long-term sustainability of forest and agro-climatic projects can only be ensured in conjunction with complex issues of territorial resilience, including key constraints on landscape resilience [11].

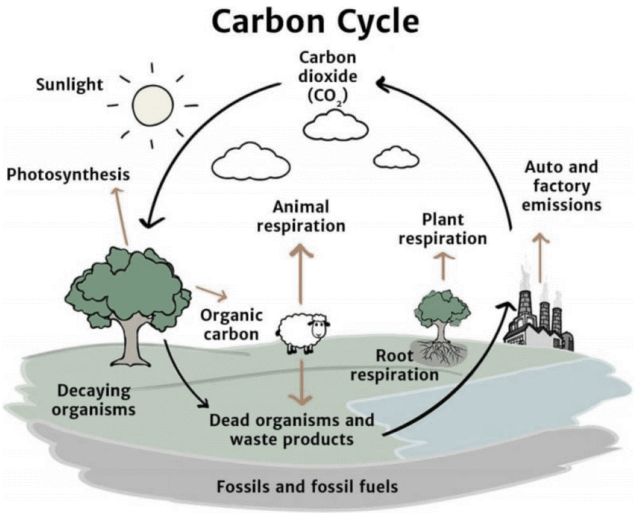

Fig. 1. Explain carbon cycle in ecosystem.

Avoiding predatory practices of nature management (illegal logging, burning, overgrazing, inefficient agricultural practices, etc.) is impossible without solving the socio-economic problems of the territories. Economic models of forest and agro-climatic projects should focus not only on solving the problems of investors represented by large companies in obtaining greenhouse gas absorption credits, but also on the contribution to employment and income of the population in the project implementation areas [9]. The search for the most effective approaches for local conditions requires the active role of both regional authorities and, in particular, municipal authorities, which for this need to be provided with the necessary resources and powers that they currently lack. Resilience projects, by their very nature, cannot be effectively implemented solely within a top-down approach. Their success is due to the "cultivation" of local initiatives and the use of local resources. In most cases, the most scarce resource is human potential - the knowledge and skills of the local community, its ability to self-organize. In this regard, it is necessary to support the existing best practices for managing territorial resilience, disseminate the experience gained to other territories with similar conditions, support educational projects in the field of territorial management and development, support local initiatives and remove existing restrictions [11].

2 Research Methodology

GHG emissions anywhere in the world affect the global atmosphere (fig.2). Thus, the deterioration of the emissions situation in one region is not a regional but a global problem.

Most developed countries have already announced ambitious goals in the field of green energy, in particular, they supported the transition to electric vehicles. The ongoing geopolitical transformation has accelerated these efforts and prompted many governments to intensify them to further reduce dependence on Russian oil and gas and hydrocarbons in general. However, the accelerated energy transition raises issues related, in particular, to the life cycle, processing and disposal of equipment involved in energy transformation, renewable energy, and electric vehicles. Over the years, the problem of the impact of business on the environment has become increasingly popular and relevant. As the consequences of environmental neglect become more and more evident over time, it is important for all stakeholders to some extent to see a green transformation of operations and supply chains (SCs).

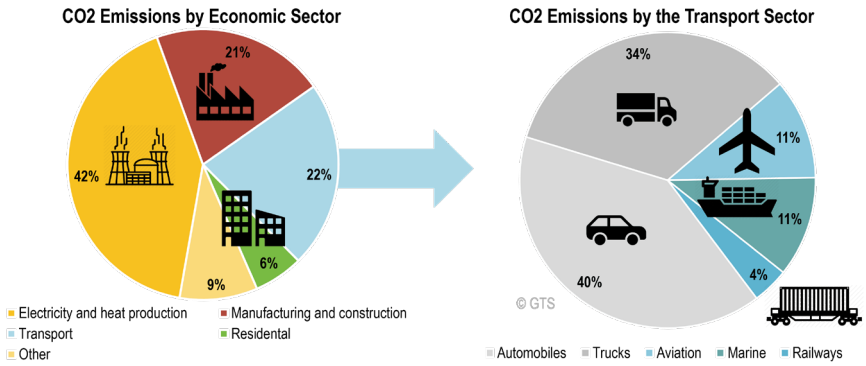

Fig. 2. Global Greenhouse Gas Emissions by the Transportation Sector

The CSU carbon site is the only place where scientific research is carried out on the development of technologies for the restoration and renewal of the vital activity of rocks in the foothill areas. Aggregate grazing management, in particular multi-arable adaptive grazing, reduces soil degradation relative to continuous grazing, and thus has the potential to reduce soil carbon emissions. The combination of crop rotation and the cultivation of perennial cover crops managed by mechanized grazing also contributes to the accumulation of organic carbon in the soil. This task was carried out as part of a project to create a pasture management tool. To increase the effectiveness of the university, they actively interact with teams in the field of climate and carbon — the National Research Brotherhood "Higher School of Economics", the Institute of Geography of the Russian Academy of Sciences, Voronezh State Forest Engineering University named after G.F. Morozov. The Institute also maintains contacts with many institutions of a geographical profile: the National Scientific Center for Ecology Research of the Faculty of Physics and Mathematics of the Peoples' Friendship University of Russia, as well as the Institute for Globalization of Climatology, named Academician Y.Israel. The plan aims to identify the most effective regenerative animal husbandry practices that can increase grassland carbon sequestration and study the impact of climate in mountain peaks or foothill landscapes. The creation of a digital model of a pasture area will allow for an analysis of the state and prospects for degradation of such areas, as well as a quantitative assessment of the volume of forage consumed, wind erosion areas and salinity zones. Sampling of aboveground herbaceous vegetation to assess the volume and quality of biomass is carried out at each site (reference site, intensive grazing). For each ecosystem, dominant plant species were summarized. In total, 62 species of vascular plants belonging to families were identified on the southern slope of the Makazhoy depression. In accordance with the objectives of the project, a mathematical model was created that takes into account the mechanisms of physical stabilization of soil organic matter. To date, parametric identification of this model is being

carried out on test sites of regenerative animal husbandry. Thus, the project will provide an opportunity to restore the quality of the soil and increase the content of soil carbon in it. The profitability of production will also be improved by increasing the density of livestock in the same areas or reducing the cost of production due to the natural restoration of pastures.

3 Results and Discussions

In the Russian Federation, there is a trend towards the creation of carbon polygons designed to monitor greenhouse gases and create a methodology for calculating the ability of the environment to absorb carbon from the atmosphere (Fig.3) [1]. In order to understand the relevance of this innovation, it is worth understanding the importance of creating landfills, establishing which regions have the greatest potential and which specialists it is important to train to work with modern environmental problems. It is important to remember that the training of personnel dealing with environmental problems is gaining popularity in connection with modern realities. A huge number of conferences and meetings are being held to discuss issues related to the emission of harmful substances, the allocation of funds for the implementation of projects to reduce anthropogenic impact, etc. Decarbonization is a process of transition to a low-carbon economy [2].

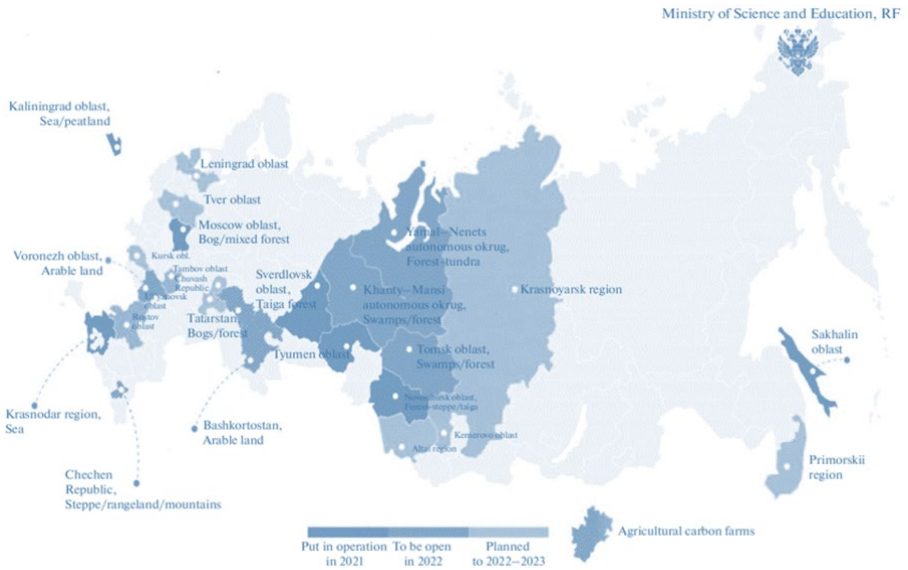

Fig. 3. Formation of a network of carbon polygons in the Russian Federation

What, in turn, is a “low-carbon economy”. A low-carbon economy is an economy based on low-carbon energy sources that has a minimum amount of greenhouse gas emissions into the atmosphere, in particular carbon dioxide [3]. Greenhouse gas emissions from human activities have been the main cause of observed climate change since the mid-20th century [4]. The continued emission of greenhouse gases can cause highly undesirable long-term climate change on a global scale, entailing serious, widespread and irreversible consequences for people and ecosystems [4]. From 2023, the European Union is preparing to introduce a "carbon tax" on imports. This threatens with high costs for producers and exporting countries [7]. Russia has chosen another way to solve this problem - science. For this reason, the development of carbon landfills is under the guidance and supervision of

the Ministry of Science and Higher Education of the Russian Federation. Minister of Science and Higher Education Valery Nikolaevich Falkov stated that it is necessary to create at least 80 scientific sites. Sequestration measurements will be carried out at these sites. In other words, to calculate how much a particular territory or object absorbs carbon and how much harmful gases it emits. For a more complete presentation and completeness of the experiment, taking into account the geographical features of climate and soil, seven regions were initially selected - from the easternmost point of Russia to the westernmost - from Sakhalin to Kaliningrad. But by 2022, the number of participating regions has dramatically increased. The first carbon site in Russia was opened in the Kaluga region by Ctrl2GO in September 2020 in the Ugra National Park. The area of this landfill is 600 hectares. We need to measure exactly the amount of CO2 that has been absorbed. This is exactly what our carbon project is aimed at. The first thing we do is to shoot the entire territory from the satellite, with different spectral characteristics, we use radars. Then we shoot the same land with the help of unmanned systems. The polygon is needed to calibrate satellite data and drone data. The identification of reference areas will allow extrapolating the results to the rest of the territory and obtaining accurate data on the absorption capacity of different types of landscapes. And a network of polygons is necessary for simultaneous monitoring of the carbon balance of large areas, - said Nikolay Durmanov, special representative of the Ministry of Science and Higher Education of the Russian Federation for environmental and biological safety, scientific director of the Carbon project of the Ctrl2GO group of companies [5]. A year after the opening of the first carbon farm, they began to appear throughout the country at an accelerated pace. The second participating region was the Tyumen region. The opening of the carbon landfill at the station of the Tyumen State University "Lake Kuchak" took place in August 2021. The area of the Tyumen test site is much smaller than the Kaluga one - 2.32 hectares, but, as the authorities of the Tyumen region guarantee, the Tyumen test site will be developed in stages, but no less efficiently. The project in the Tyumen region was financed by a large oil and gas chemical company PJSC SIBUR. Each polygon is created in partnership between universities and scientific organizations. Each of them has a unique research agenda and an educational and outreach mission. Our task is to include in this great work and raise the level of culture on the problem among students and schoolchildren, - Minister Valery Falkov noted at the opening of the project [6]. The implementation of the "carbon" project in the Krasnodar Territory is planned in Gelendzhik. On Sakhalin, it is planned to cover Aniva Bay first, and after 2023 Iturup Island. The opening of the Sakhalin farm will be led by the Sakhalin State University, and the largest companies in the region will provide financial support. The Rosyanka carbon polygon in the Kaliningrad region was organized on the Wittgirrensky peat bog. The operator of the project implementation was the Baltic Federal University. Kant. Technological partners are the Atlantic Branch of the Institute of Oceanology of the Russian Academy of Sciences, IP Kukushkin, GBU KO Vyshtynetsky Natural Park. The industrial partner of this project is the group of companies Ctrl2GO [8]. The project participant is the Institute of Forest Science of the Russian Academy of Sciences. There is a mobile laboratory at the Baltic test site, where express analyzes of freshly taken samples are carried out. Work at the site is carried out on a rotational basis. It should be noted that each region participating in the "carbon" project has an implementation schedule. Below is an example of a project implementation plan in the Kaliningrad region.

4 Conclusions

Due to the huge number of environmental problems in modern society, including the problem of carbon dioxide emissions, such terms as "carbon farm" and "carbon landfill" have appeared in the scientific community. Despite the similarity of concepts, these terms are still different. The main difference between these two on the website of the Ministry of Public Education was explained by the main educator of the carbon theme, expert Nikolai Durmanov. We have two sides of the same coin: carbon landfills are where measurement methods are being researched, and carbon farms are a place where these methods are put into practice so that we have highly efficient technologies for absorbing carbon dioxide by terrestrial ecosystems. After all, plants do an excellent job of extracting CO2 and storing it as plant biomass, such as forests, or in the soil. Carbon farms are needed in order to absorb carbon dioxide as actively as possible with the help of the plant world, our ecosystems, whether it be forests, plantations of special plants or agricultural lands on which special agricultural technologies are used [9]. The carbon farm appeared exactly on the carbon landfill of the Kaluga region, where, along with other woody plants, paulownia seedlings were planted, in the common Adam's tree. Paulownia is very well cultivated in urban environments, as it captures carbon dioxide, dust and noise 4 times better, and releases 4 times more oxygen. This tree culture is widespread in Paris. In the Voronezh region, a forest carbon plantation is being created, the area of which is 3 thousand hectares, where scientists from the Voronezh State University. G.F. Morozov experimental method will identify the most carbon-absorbing rocks. The plants required for the “tests” are unpretentious, have high winter hardiness, and are shade-tolerant. For example, the mountaineer Weirich, the Syrian milkweed, the ball-headed muzzle, etc. Plants do not leave harmful substances after the death, they can be safely disposed of. Some species are used as biofuel, some are used as food for people and animals [10].

An average of 15 million rubles is allocated from the state budget for the implementation of a carbon landfill. for scientific research and 17–18 million for practical equipment. In addition, Russia is the state with the richest forest fund, which gives it an advantage to become the world leader in carbon dioxide absorption. It is necessary to translate this potential into a monetary equivalent as soon as possible. The action strategy is as follows: calculate the "carbon" balance → sale of cultivated crops → development of the country's economy. Literally increase the economy of the state, sell clean air.

Acknowledgments

The work was carried out within the framework of the state assignment of the Ministry of Science and Higher Education of the Russian Federation (topic No. 075-03-2021-074 / 4).

References

1. R. A. Gakaev, I. A. Bayrakov, M. I. Bagasheva, Ecological foundations of the optimal structure of forest landscapes in the Chechen Republic, 50-52 (2006)
2. R. A. Gakaev, Comprehensive assessment of the current state of the mountain-forest landscapes of the Chechen Republic and measures for their optimization. In the collection, 189-194 (2008)
3. C. Cagnin, E. Amanatidou, M. Keenan, Orienting European Innovation Systems towards Grand Challenges and the Roles that FTA Can Play, **39(2)**, 140–152 (2020)
4. E. Reynard, M. Panizza, Geomorphosites: definition, assessment, and mapping. Geomorphol Relief , 177–180 (2018)

5. EU-Russia Energy Dialogue, Energy Forecasts and Scenarios 2009–2010 Research. Final Report (2021)
6. K. Haegeman, F. Scapolo, A. Ricci, E. Marinelli, A. Sokolov, Quantitative and qualitative approaches in FTA: from combination to integration?, **80**, 386–397 (2021)
7. R. Kh. Ilyasov, Spline modeling and analysis of relationships in the economy with the possible presence of regression switching points, **11(4)**, 165-175 (2018)
8. K. M.-S. Murtazova, Ecological and economic assessment of sectoral agricultural technologies, **3(15)**, 68-71 (2021)
9. A. S. Salamova, Socio-economic factors in the fight poverty and hunger in the modern world: the scientific approach of Amartia Kumar Sen, **17(1)**, 237-245 (2023)
10. A. S. Salamova, Global networked economy as a factor for sustainable development, 03053 (2020)
11. Sustainable development during a pandemic: natural resources, climate change and territorial resilience, report. National research University "Higher School of Economics", 76 (2021)
12. Y. Şehitoğlu, M. F. Şengüllendi, M. Bilgetürk, The Manager, **13(2)**, 85-103 (2022)