Engineering of the Carbon Sequestration Function of Ecosystems in Climate Projects

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Abstract: This article is devoted to the engineering of the carbon-depositing function of ecosystems in climate projects. The projects implemented in Western Siberia of Russia are considered. If earlier agriculture was perceived, on the one hand, as one of the causes of climate change, and on the other hand, as one of its main victims, and the question was raised only about reducing the impact of climate change on agricultural production and its adaptation to a changing climate, today we are talking about that agriculture can become a source of technologies that ensure the removal (sequestration) of greenhouse gases from the atmosphere. Farming methods aimed at capturing carbon from the atmosphere are known as carbon (or carbon) farming. The essence of carbon farming is to increase soil carbon by increasing the amount of carbon put into the soil and reducing the rate of carbon loss through respiration and soil erosion. The reduction of greenhouse gas emissions associated with agriculture is achieved, among other things, by minimizing the use of agrochemicals (fertilizers, plant protection products).

1 INTRODUCTION

Traditionally, the main driving force behind the global climate agenda is the European Union. In recent decades, the fight against climate change has become one of the main leitmotifs of his domestic and foreign policy. These ideas are reflected in the priorities of the work of the new European Commission for 2019-2024. The fundamental document for the implementation of European initiatives in this area is the European Green Deal strategy, presented by the European Commission in December 2019. The stated goal of the Green Deal is to achieve carbon neutrality of the EU by 2050.

Referring to the risks of not achieving the goal of the Paris Agreement due to the unambitiousness of the obligations assumed by its participants, the EU proceeds from the need to introduce border carbon barriers, which involve the collection of additional fees on imported goods produced in countries with an unacceptably low level of climate regulation.

The European Parliament's Committee on International Trade calls for the Paris Agreement and its target of keeping the Earth's temperature rise to within 1.5 degrees Celsius as "one of the main guiding principles" of EU trade policy, with which "all initiatives must be synchronized in the field of trade and tools for their implementation (Sohngen, 2005). A key initiative is the project to introduce a "border carbon correction mechanism", the essence of which is to levy a fee on products with a high carbon footprint imported into the EU. In fact, we are talking about the unilateral coercion by the European Union of its trading partners to implement climate measures similar in scale to those carried out by the EU itself. The new US President also makes statements about the high priority of the climate agenda. The process of bringing climate problems to the forefront of the international agenda is becoming irreversible. It is very likely that the threat of losing European market share will induce many EU trading partners to take radical measures to combat climate change, and hence, in the future, to erect similar trade barriers to protect their own producers from foreign products, the price of which does not include the cost of combating climate change. climate change.

If the specific form of implementation of the EU border mechanism, in the presence of, for example,

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discriminatory elements, can be challenged in international courts, the prospects for recognizing the very idea of \u200b\u200bsuch a mechanism as illegitimate do not seem serious. The introduction of frontier carbon charges is just one manifestation of the green development of the global economy. In addition to strengthening national emission reduction policies (to date, 127 countries have announced plans to achieve carbon neutrality, including China and the United States), a growing number of large investment funds, pension funds, insurance companies and other institutional investors are indicating plans to divest assets from coal, oil and even gas projects (Kurbanov, 2008). In the corporate sector, sectoral emission control and regulation systems are being introduced (including the Corsia system in international civil aviation); Globally, there is a rapidly growing number of companies seeking to reduce their carbon footprint along the entire value chain in response to growing climate reporting requirements from investors.

2 MATERIALS AND METHODS

Carbon farming in agribusiness and forestry can also be a tool to overcome trade barriers for carbon-intensive exports, including agro-exports.

The EU's plans to introduce a frontier carbon adjustment mechanism have prompted many producers of carbon-intensive products exported to the EU to rethink their carbon strategy. Over the past few months, it has become clear that the emergence of such a mechanism in one form or another is inevitable. Moreover, similar measures can be taken in the United States: the program of the new president directly provides for the introduction of a "corrective carbon levy" in relation to countries "not fulfilling their obligations on climate and environmental protection." If this scenario materializes, there is a high probability of a domino effect triggering: exporters to these markets will be forced to switch to higher carbon standards of importing countries, and therefore protect their producers with similar measures. Russia's failure to take steps to develop and implement a strategy to reduce greenhouse gas emissions will mean a gradual narrowing of export markets. It may turn out that there will simply be nowhere to switch from the EU market: similar barriers will be erected in other markets (Sidarenko, 2006). Challenging the “carbon adjustments” in the World Trade Organization is unlikely to lead to the desired results: if the specific forms of implementation of the mechanism can be recognized as inconsistent with certain WTO rules (for example, on the prohibition of discrimination), the very idea of such a mechanism is subject to its support economic centers of the world, including the EU and the USA, and the emergence of climate change issues at the forefront of the international agenda - with a high probability will be recognized as legitimate.

In addition, the WTO dispute resolution system remains blocked today (the US is preventing the appointment of members of the Appellate Body, citing irregularities in its work; the new administration has not yet demonstrated a willingness to change the situation in the foreseeable future), so filing a complaint in the near future is futile. Thus, having won a dispute with the EU on energy adjustments last year, Russia cannot enforce the decision of the arbitration panel, since the EU filed an appeal with the non-functioning Appellate Body, thereby maintaining the status quo indefinitely. Initiatives to price carbon – whether in the form of a carbon tax or an emissions trading system – are on the rise around the world, numbering around 60 to date. before.

3 RESULTS AND DISCUSSION

Africa's first carbon tax was introduced in the Republic of South Africa (SAR), with Singapore pioneering in Asia. On February 1, 2021, the national emissions trading system began to operate in China. In these circumstances, one of the key elements of Russia's response to climate threats and related trade barriers could be agriculture and forestry. It is very likely that in the future, agricultural products will somehow fall under the EU's corrective mechanism. Given that the agricultural sector is the subject of special protection in the EU, there is no reason to believe that, by protecting competition in its market with a carbon corrective mechanism, the European Commission will refuse to use this tool to protect the European agricultural producer (Gitarsky, 2006). Moreover, at the international level, an understanding is beginning to form that, in the issue of climate change, agricultural production “is not only the source of the problem, but also a key element of the solution.” If earlier agriculture was perceived, on the one hand, as one of the causes of climate change, and on the other hand, as one of its main victims, and the question was raised only about reducing the impact of climate change on agricultural production and its adaptation to a changing climate, today we are talking about that agriculture can become a source of technologies that ensure the removal (sequestration) of greenhouse gases from the atmosphere.

Farming methods aimed at capturing carbon from the atmosphere are known as carbon (or carbon) farming. The essence of carbon farming is to increase soil carbon by increasing the amount of carbon put into the soil and reducing the rate of carbon loss through respiration and soil erosion. The reduction of greenhouse gas emissions associated with agriculture is achieved, among other things, by minimizing the use of agrochemicals (fertilizers, plant protection products). In many ways, synonymous with carbon farming is the concept of "regenerative" (that is, restorative) agriculture, which refers to a set of non-destructive agricultural practices that ensure soil restoration in the process of managing (Ivonin, 2009). With the help of modern breeding methods, it is possible to obtain regenerative varieties with the appropriate characteristics and technical characteristics. As part of the new climate agenda, it is necessary to develop varieties and types of agricultural plants, including fundamentally new ones, that would have the ability to suppress weeds, resist pests and diseases without the help of agrochemistry.

Ecosystems of the Future: Engineering Carbon Sequestering Bio- and Ecosystems in Regenerative Land Use

Global natural changes and an increase in the demand of citizens for the quality of the environment require effective forecasting and counteraction to the implementation of negative future scenarios.

Traditional land use technologies in agriculture and forestry do not meet modern requirements for maintaining ecosystem resilience, maintaining soil health and biodiversity (Polyakova, 2011). Modern agricultural practices are aimed at maximizing productivity by depleting environmental components and artificially shifting the ecosystem balance. A transition to regenerative land use with a focus on carbon sequestration is needed

"Carbon landfills" of the West Siberian megatransect: dynamics, functions and mechanisms of stabilization of climatically active gases in ecosystems of various ranks will ensure the formation of the university's leadership position in the field of engineering of carbon landfills and stations through the development of methods and models for monitoring CAG flows in various ecosystems.

Project objectives:

Implement a program of field experiments, including at the carbon landfills being created (the pilot site was opened in August 2021 at the Tyumen State University biostation on Lake Kuchak), for different natural zones from the forest-steppe to the Arctic.

Models of changes in the carbon balance in various natural and anthropogenic systems under current and future land use and climate change have been created using Earth remote sensing technologies. Technological products "Carbon Calculator" and Neuromaps were developed using artificial intelligence technology to calculate carbon balances by land users for the implementation of climate projects in agriculture and forestry. Adapt these products for the practice of agriculture and forestry (with the Institute of Economics and Organization of Industrial Production of the Siberian Branch of the Russian Academy of Sciences).

Software and hardware tools for predicting and assessing the biosequestration potential have been developed by studying the chlorophyll-bearing parenchyma of plants at the level of an individual leaf and leaf canopy to develop software and hardware tools for predicting and assessing the biosequestration potential of plants (with the Botanical Garden of the Ural Branch of the Russian Academy of Sciences)

New educational programs (Master's, APE) on accounting for balances of climatically active gases have been implemented in partnership with leading research centers (IPEE RAS, Southern State University, University of Münster).

A package proposal for the engineering of carbon landfills and carbon stations for various types of ecosystems for external customers has been formed.

The Role of Different Types of Western Siberian Water Bodies in the Carbon Balance

The goal is to assess the role of water bodies in the carbon balance of the main natural zones of Western Siberia in order to assess their contribution to the overall carbon balance of the territory of the macroregion.

Project objectives:

A network of stations has been created for long-term monitoring of the balance of greenhouse gases in typical natural water bodies.

Studies have been carried out on the dynamics of the balance of greenhouse gases in the territories with a change in the hydrological regime, leading to the creation of artificial or the disappearance of natural water bodies (Porfiriev, 2010).

A parametric mathematical model of the cycle of organic matter in typical water bodies of the region has been developed.

Create a methodology for calculating changes in the carbon balance of water bodies, taking into account hydrological features and climatic trends in Western Siberia.

Methodological recommendations for the calculation of the carbon balance in the technogenic

development of territories with a change in the water regime of natural water bodies or the creation of artificial reservoirs are proposed.

Sequestration and adaptive potential of plants in extreme conditions of the Northern Trans-Urals

The goal is to develop a new model of regenerative farming based on the bioresource collection of Tyumen State University and its use in agriculture and forestry in the macroregion.

Project objectives:

The bank of plant genomic diversity has been expanded.

Species, varieties were selected and new forms of cultivated plants for regenerative agriculture with high adaptive properties were created, the variability of morphometric parameters and physiological properties of plants in response to biotic and abiotic stress factors (lack of water, salinity, extreme temperatures) was studied.

Agrotechnical methods for growing ground cover plants for the tasks of regenerative agriculture have been developed.

Methods and a set of crops are proposed for the transition of agricultural producers to regenerative methods of cultivation of agricultural crops.

New methods of phytorestoration and bioremediation of technogenically disturbed territories have been developed, including the selection of materials that provide carbon sequestration.

As a result, new ways were proposed to increase the biosequestration potential of agriculture and forestry in the Tyumen region and on a national scale through the introduction of innovative environmentally sound agrotechnological technologies.

3.1 Creation of a Distributed Center for Genomic Analytics

The goal is to create an analytical service for the use of genomic technologies with its subsequent introduction into agrotechnological practice.

Project objectives:

A service for metagenomic screening of the environment has been created - an informative toolkit for assessing the quality of the environment and biodiversity.

The complex of bioinformatic methods for assembling and analyzing genomes and transcriptomes has been optimized.

Scaled barcoding (genetic barcoding) of ticks, insects and microorganisms of the macroregion for environmental screening.

Two new research laboratories have been established under the leadership of young scientists in the field of ecological genetics and phylogenetics. Competence center in the field of functional research of soil biota was established

Thus, breeding for these sorts of varieties and species is more complex than breeding for homogeneous, manageable, high-yielding systems. But it is necessary in the face of declining global resources with a growing population of the planet, as well as taking into account the inevitable introduction of strict carbon standards, fines, and quotas into the agricultural industry (Nikoláeva, 2018). The subject of selection work should be non-obvious properties and point effects on molecular mechanisms, and not simple formulas like "yield / cost". Forests, in turn, are the main natural sink of greenhouse gases in terrestrial ecosystems in the world. As the world's leading forest power, Russia has natural natural capital in the form of forests accumulating 625 million tons of greenhouse gases annually. This gives Russia significant competitive advantages, since the absorption of greenhouse gas emissions by forests occurs without significant costs from the state, the cost of measures to reduce emissions - for example, to extinguish forest fires - is moderate (3 billion rubles per year) compared to other types of measures, for example, to improve energy efficiency in industry. In general, in Russia there is a huge and still not used reserve for reducing the carbon footprint of products due to the existing protective and other categories of forests on agricultural lands (Porfiriev, 2010). Forests located on agricultural land are of great importance for the absorption of greenhouse gases.

4 CONCLUSIONS

In general, Russia has a huge untapped reserve to reduce the carbon footprint of products through existing protective and other forest categories on agricultural land. Forests located on agricultural land are of great importance for the absorption of greenhouse gases.

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