CARBON LANDFILL AS A RISK MANAGEMENT TOOL IN THE SYSTEM OF SUSTAINABLE DEVELOPMENT

Konstantin Ordov[1], Seda Aslakhanova[2]

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[1]Russian University of Economics named after G. V. Plekhanov, Russia
[2]Chechen State University named after A.A. Kadyrov, Russia
ordov-reu@mail.ru
salamova_chgu@mail.ru

Abstract

Adaptation to climate change, implementation of the new climate agenda and a number of international climate agreements and standards require scientifically based information and analytical support of the country's economy and population with data on the current and expected states of the climate system. Particularly relevant are the development and testing of technologies for controlling greenhouse gas emissions and calculating the carbon balance of territories. Climate change affects, to one degree or another, the sphere of interests of any subject of the Federation and practically any sector of the economy and social sphere of the Russian Federation. The planning and implementation of many large investment and production projects are highly sensitive to climate and climate change issues and require efforts to ensure that the implemented measures are cost-effective and at the same time contribute to reducing the risks and mitigating the effects of a changing climate, ensuring social and environmental security. At the same time, it is important to keep in mind that, in addition to a direct impact on the economy and population of the Russian Federation, the weather and climate factor has a significant impact on the system of international trade, economic and political relations. This article shows that it is carbon polygons that are the tool of modern climate policy that provide observations, assessment and forecasting of climate change and its consequences, as well as allow developing and testing technologies for remote and ground monitoring of greenhouse gas emissions and other parameters significant for climate change.

Keywords: carbon polygons, greenhouse, gas emissions, climate, environmental protection.

I. Introduction

Earth's average surface temperature has increased by 1.3 degrees Fahrenheit over the past century and is projected to increase by another 3.2 to 7.2 degrees in the 21st century, according to the Intergovernmental Panel on Climate Change [1]. These seemingly minor changes in temperature can have serious consequences for farmers. According to the Environmental Protection Agency, an increase in average temperature can: lengthen the growing season in regions with relatively cool spring and autumn periods; adversely affect crops in regions where summer heat is already limiting production; increase the rate of soil evaporation; and increase the likelihood of severe droughts. Innovative farming practices such as conservation tillage, organic production, improved farming systems, land restoration, land use change, and irrigation and water management are ways farmers can address climate change. Good management practices have many benefits that can also improve profitability, improve farm energy efficiency, and improve air and soil quality [2,3].

Carbon farming describes a set of sustainable practices that are capable of increasing soil carbon uptake, i.e. carbon sequestration. Increasing soil carbon sequestration will help reduce CO2, CH4 and N2O emissions into the environment. Carbon farming, which results in the reduction of greenhouse gas (GHG) emissions, is referred to as abatement activities. It holds carbon in vegetation and soil and reduces greenhouse gas emissions [4]. A carbon offset credit is a payment made by a carbon emitter (power plant, mine, refinery, etc.) to the developer or owner of a carbon sequestration process (forest reserve owner, biochar project developer, etc.). Carbon farming involves one land management change such as zero tillage, agroforestry, methane-reducing feed additives, or stubble retention that maximizes carbon sequestration and emission reductions1. In carbon farming, CO2, CH4, and N2O will decrease with increasing soil carbon uptake due to increased soil aeration by adding organic carbon, which reduces denitrification and increases CH4 uptake capacity. Soil organic carbon adds electron acceptors and increases the redox potential of the soil, decreasing its ability to source N2O [4]. Carbon farming causes microbial immobilization of available N2 in the soil, which reduces the soil's capacity as a source of N2O2. There are several promising options for reducing greenhouse gas emissions in carbon agriculture; storing carbon in soils and degraded grasslands through forests, tree planting and regrowth, storing carbon through the incorporation of biochar which is carbon negative, and replacing fossil fuels with biofuels. Carbon farming gives landowners the opportunity to earn carbon credits by storing carbon or reducing greenhouse gas emissions from their own land. These carbon credits can then be sold to a government-appointed body that wishes to offset its emissions [5]. In fact, carbon agriculture is a voluntary carbon offset scheme that provides economic rewards to landowners who take steps to reduce greenhouse gas emissions. Carbon farming reduces emissions by capturing when carbon is stored on the ground and avoiding emissions, which prevents greenhouse gas emissions from escaping into the atmosphere. It involves the implementation of practices that improve the rate at which CO2 is removed from the atmosphere and converted into plant material and/or soil organic matter. Carbon farming is successful when carbon gains from improved land management and/or conservation practices exceed carbon losses [6]. Its benefits include reducing greenhouse gas emissions, sequestering carbon, increasing biodiversity, protecting against drought, and improving water use efficiency. The development of various programs will facilitate the buying and selling of carbon credits between landowners and government agencies. Landowners receive carbon credits for storing carbon in the soil, and then the credits are collected and sold to reduce emissions. These loans are often bought independently of the exchange, they can boost the client's financial position and help prove how useful these methods are in mitigating the effects of an industrial society. Nanomaterials are of great interest in various fields due to their unique and useful chemical, physical, mechanical and biological properties [6]. However, these properties also endow ENM with an innate ability to interact with biological systems, which can lead to detrimental environmental impacts (or even to the restoration of contaminated soil and groundwater). The properties of materials such as gold, silver, or nanoform iron can differ significantly from those of the original materials. This is leading to a number of new applications for such materials in items including foodstuffs and food packaging materials [7]. For example, quantum dots, fullerenes, carbon nanotubes, silicon dioxide and silver nanoparticles can be found in electronics, cosmetics, and food packaging. Some of them are safe, and some may pose a risk to the environment and human health. A recent study showed that by 2010, 63–91% of the more than 300 kilotons of ENM produced worldwide ended up in landfills; 8–28% got into the soil, 0.4–7% into surface water bodies, and 0.1–1.5%2 into the atmosphere. However, the study was a broad global assessment. In developing countries such as India, the scale of potential massive releases of ENM to the environment needs to be studied in detail [6,7]. Unlike developed countries (USA, Europe or Japan), the Indian industry has become interested in nanotechnology only recently, and many large companies have now initiated nanomaterials programs on their own or in collaboration with academic/research institutions. Many of these companies are working on value-added applications of nanomaterials, despite the increased use, there is limited or no information available on the disposal of waste nanomaterials in the Indian subcontinent. If nanomaterials are carried in landfills or in soil, they can end up in drinking water sources or large surface water bodies. Given that most nanomaterials end up in soil, understanding the impact of these nanomaterials on soil organisms or ecosystems is required for sound risk assessment and policy discussion. Interestingly, most of the potential dangers of these nanomaterials are not documented, and ordinary people are not aware of this.

Important research is available around the world on the presence of nanoparticles in some foods sold in supermarkets, but the health effects of nanomaterials used in foods are not well understood, even by manufacturers or large companies. However, recent research indicates that nanomaterials (such as carbon nanotubes, nanoclay, and metal oxide nanoparticles) are present in some food packaging materials and are involved in several stages of the food chain. They are expected to improve packaging performance and ultimately the longevity of food products in consumer markets. In addition, they are used for invisible nano-alignment or nano-barcodes. However, the impact of nanomaterials from food packaging on human health is lacking both in the Indian market and globally. It is also not well known what types and categories of nanomaterials can be dangerous and to what extent for the human body and the environment. Thus, consumers of such food products and commercial products based on nanotechnology produced by national and international companies may need sound guidance.

II. Methods

Natural shifts in global temperatures have occurred throughout human history. However, in the 20th century, global temperatures increased dramatically. Scientists attribute the rise in temperature to an increase in carbon dioxide and other greenhouse gases emitted from fossil fuel burning, deforestation, agriculture and other industrial processes. Scientists call this phenomenon the enhanced greenhouse effect [7]. The natural greenhouse effect traps the sun's heat before it can be released back into space. This allows the Earth's surface to remain warm and habitable. Elevated levels of greenhouse gases amplify the natural greenhouse effect by trapping even more heat from the sun, resulting in global warming. The main greenhouse gases associated with agriculture are carbon dioxide (CO2), methane (CH4) and nitrous oxide (N20) [8]. While carbon dioxide is the most common greenhouse gas in the atmosphere, nitrous oxide and methane stay in the atmosphere longer and absorb more longwave radiation. Therefore, small amounts of methane and nitrous oxide can have a significant impact on climate change. Several excellent resources and fact sheets explain the greenhouse effect and the science behind climate change. Climate change can have both beneficial and detrimental effects on agriculture. Some studies show that warmer temperatures lengthen the growing season, and increased carbon dioxide levels in the air result in higher yields for some crops. A warming climate and lower soil moisture may also lead to a northward shift in production patterns and increased demand for irrigation. Changes, however, are likely to vary considerably by region. Geography will play a big role in how agriculture can benefit from climate change. Although forecasts for some areas look favorable, the possibility of increased climate variability and extreme events is not necessarily taken into account. The benefits to agriculture could be offset by increased chances of heatwaves, droughts, severe thunderstorms and tornadoes. Increasing climate variability makes it difficult for farmers to adapt, especially to farming systems, grazing and grazing and animal husbandry [6,7]. We highlight the following issues: With increasing carbon dioxide content and higher temperatures, the life cycle of grains and oilseeds is likely to develop faster. Marketable crops of many horticultural crops, such as tomatoes, onions and fruits, are likely to be more sensitive to climate change than grains and oilseeds. Climate change is likely to lead to northern migration of weeds. Many weeds respond more positively to increased carbon dioxide than most cash crops [8]. Disease pressure on crops and livestock is likely to increase with earlier spring and warmer winters. The projected increase in temperature and lengthening of the growing season is likely to extend fodder production into late autumn and early spring. Pasturelands are already undergoing changes in plant species due to climate change. Planting perennial herbaceous species reduces the availability of soil moisture early in the growing season. Higher temperatures are likely to reduce livestock production during the summer season, but these losses will be partly offset by warmer temperatures during the winter season. Thus, agriculture and forestry can give Russia the opportunity to be not an object, but one of the key subjects of the global climate agenda, offer other countries solutions to the climate challenges they face and not only not lose, but also win in the conditions offered to it [9]. According to the authors of the report, in order to realize the existing potential of Russia, it is necessary to: ensure transparency in the development of the regulatory and legal framework for standards for measuring and reporting on greenhouse gas emissions, including monitoring, verification, certification of projects based on clarifying scientific knowledge about absorptions on agricultural lands and in forests, including within the framework of carbon polygons; revise the national quantitative goal to reduce greenhouse gas emissions in the direction of its tightening; launch a system of voluntary projects to create opportunities for Russian companies interested in reducing their carbon footprint to implement projects in this area (these can be airlines subject to CORSIA or companies subject to border regulation); move towards building a full-fledged regulatory system in the country with incentives for companies to reduce emissions (based on the price of carbon - in the form of an emissions trading system, carbon tax or their hybrid form) with the possibility of embedding voluntary projects to reduce emissions (including in sectors forestry and land use); to intensify the negotiation process with the EU on offsetting units of reductions in the framework of Russian projects to reduce emissions - initially for the purpose of reduction.

III. Results

The widespread recognition of the problem of climate change is forcing scientists and corporations to look for ways to reduce the carbon footprint of the economy, including the extraction of greenhouse gases already in the atmosphere. Modern research highlights a whole range of sequestration strategies: physico-chemical; biological; geological [8]. Physical-chemical approaches are mainly used in industry, energy and transport to reduce new emissions and include the use of adsorbents and separation membranes to capture, compress and transport greenhouse gases. Biological and geological methods make it possible to reduce the volume of gases accumulated in the atmosphere. Geological methods involve the injection of greenhouse gases into underground storage facilities (eg depleted deposits) [4,5,6]. This solution is very reliable from a safety point of view (most storage facilities will not be disturbed by tectonic processes over the next million years), but from an economic point of view, sustainable economic models have not yet been found to build a stable sequestration industry using geological methods. Biological methods involve using the potential of natural living systems to sequester carbon. Plants, algae, bacteria in the soil in the bottom silt are natural "devices" for absorbing greenhouse gases. There are several key areas of application of biological methods: (a) the targeted cultivation of algae and bacteria for the production of biofuels, as well as plant crops for the production of biofuels and biochar (or biochar - coal of vegetable origin with a carbon content of 93-99% and the absence of harmful and toxic impurities); b) restoration of living ecosystems that absorb carbon

[10]. As a result of human economic activity, the volume of plant biomass on the planet has significantly decreased - deforestation and desertification are rapidly taking place, and the adsorption capacity of aquatic ecosystems is decreasing due to pollution of freshwater reservoirs, seas and oceans. Restoring these systems - in particular forests and swamps - is one of the most promising solutions in terms of sequestration. Thus, today the strategy of reducing the carbon footprint through biological methods can be considered dominant. Let's take a look at a few basic ways to implement this strategy. Agricultural activities serve as both a source and sink of greenhouse gases. Agricultural sinks of greenhouse gases are reservoirs of carbon that are removed from the atmosphere through the process of biological carbon sequestration. The main sources of greenhouse gases in agriculture are the production of nitrogen fertilizers; burning fossil fuels such as coal, gasoline, diesel and natural gas; and waste management. The enteric fermentation of livestock or the fermentation that occurs in the digestive system of ruminants results in the release of methane. Carbon dioxide is removed from the atmosphere and converted into organic carbon through photosynthesis. When organic carbon decomposes, it turns back into carbon dioxide through the process of respiration. Protective tillage, organic production, cover crops, and crop rotations can dramatically increase the amount of carbon stored in the soil. Agricultural carbon sequestration refers to the ability of agricultural land and forests to remove carbon dioxide from the atmosphere. Carbon dioxide is taken up by trees, plants and crops through photosynthesis and stored as carbon in biomass in tree trunks, branches, foliage, roots and soil. Forests and grasslands are called carbon sinks because they can store large amounts of carbon in their vegetation and root systems for long periods of time. Soils are the largest terrestrial carbon sink on the planet [8]. The ability of agricultural land to store or sequester carbon depends on several factors, including climate, soil type, type of crop or land cover, and management practices. The amount of carbon stored in soil organic matter is affected by the addition of carbon from dead plant material and the loss of carbon through respiration, decomposition, and both natural and anthropogenic impacts on the soil. By adopting farming practices that minimize soil disturbance and promote carbon sequestration, farmers can slow or even reverse the loss of carbon in their fields. In the United States, forests and arable land currently absorb the equivalent of 12 percent of US carbon dioxide emissions from the energy, transportation, and industrial sectors.

IV. Discussion

The main benefit of a carbon or greenhouse gas tax would be to create a stream of tax revenue that the government could use to further incentivize the practical and technological changes needed to reduce greenhouse gas emissions [4]. For example, many of the current agricultural conservation programs, such as the Environmental Quality Incentive Program and the newer Conservation Management Program, support improving soil quality and can be partly funded by taxes on emissions or carbon emissions, thus providing a source of income to subsidize those that adopt or support emission reduction methods or carbon sequestration activities. For more information, see the ATTRA publication Federal Resources for Sustainable Agriculture and Livestock. Tax revenues could also help support conservation programs such as the Wildlife Conservation Program, which aims to keep sensitive and erosive land from being exploited as these lands sequester soil carbon. Another benefit of this approach is that the tax provides a clear and stable cost to current practices. The tax also makes it easier to identify changes that will be more profitable under new cost conditions. For example, if a concentrated animal feed business understood the cost of its emissions in terms of an emissions tax, it would be easier for it to identify cost-effective alternatives to existing methods. With a sufficiently high tax rate, it would make economic sense to install methane reactors to reduce greenhouse gas emissions [5]. Finally, it has been argued that the carbon tax approach is cost-effective to implement, at least compared to cap-and-trade, to achieve greenhouse gas emission reductions. As a recent report from the Congressional Budget Office puts it: “Available research suggests that in the short term, the net benefits (benefits minus costs) from the tax could be about five times greater than the net benefits from the inflexible cap.”

Modern breeding methods make it possible to obtain "regenerative" varieties with a fairly wide range of traits and technical characteristics. Such varieties are able to produce acceptable yields in conditions of minimal use of agrochemicals, ensure the preservation of the genetic diversity necessary to maintain stable yields in unstable climatic conditions. 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 [6]. In addition to increasing nutritional value, the optimization of the interaction of plants with microbial communities in the soil should be taken into account. This applies mainly to the structure and functional features of the root system of cultivated plants [7]. Such varieties may not have the highest yield, but at the same time have the ability to adapt to stressful conditions of both biotic and abiotic nature. In breeding work, it is necessary to pay attention to such criteria for the quality of varieties as delayed leaf aging, nutrient savings, ecological suitability for local conditions, stable yields, resistance to pests and diseases, and overall low production costs. The so-called hit-and-run criterion is becoming popular, which refers to the absence or minimum need for care from the moment of sowing until harvest.

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