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CARBON SEQUESTRATION IN LANDSCAPES OF THE CHECHEN REPUBLIC

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Abstract

The global problem is to achieve the set goals for reducing emissions, it is necessary to invest in the development of new ways to reduce carbon emissions in the atmosphere by accelerating convergence in key areas. Looming climate tipping points require public and private participation in scaling up climate responses by creating opportunities for rapid progress that improve human conditions through the provision of ecosystem services and socio-economic development. Efforts to mitigate climate change are based on two imperatives: decarbonizing our energy production systems and removing carbon dioxide (CO_2) from the atmosphere. As described below, Natural Climate Solutions (NCS) represent a promising path to restoring climate stability by reducing atmospheric CO_2 emissions while maintaining and improving critical production systems and ecosystem services.

Keywords: reduction of emissions, carbon, acceleration of convergence, climate, decarbonization, ecosystems.

The landscapes of the Chechen Republic (CR) are characterized by exceptional diversity, which is associated with the confinement of its territory to the Ciscaucasia and the northern slope of the Greater Caucasus [1]. The presence in a small area of a wide range of landscapes (from semi-desert in the north to glacial-nival in the south) attracts the attention of many researchers. Modern exogenous processes are manifested on the territory of the republic very intensively. Their occurrence and course are due to many factors. As a result of economic activity, industrial and motor transport enterprises of the Chechen Republic in 1991, 482 thousand tons of harmful substances were emitted, including 342 thousand tons in Grozny. Main pollutants: hydrocarbons (50%), carbon monoxide (32.8%), sulfur dioxide (8.7%), nitrogen oxides (4.3%). In subsequent years, the level of pollution increased sharply due to the influx of pollutants from the combustion of oil flares and artisanal oil refineries [2].

The main reasons for the high level of air pollution are [2-3]:

- unsatisfactory fulfillment of the state plan for environmental protection ("Grozneftegaz", "Groznefteorgsinetez", "Chechen Cement Plant");
- the slow pace of implementation of low-waste and non-waste technologies (the firm "Terek", "Red Hammer");
- weak departmental control over the state of air pollution and the efficiency of treatment facilities (Grozneftegaz, Terek Firm, Agro-industrial complex).

Efforts to mitigate the effects of climate change must stabilize atmospheric concentrations of greenhouse gases at levels that prevent dangerous anthropogenic interference. For example, the Intergovernmental Panel on Climate Change (IPCC) defines several categories of climate impacts on ecosystems and societies, from risks to vulnerable ecosystems to large-scale changes in temperature and precipitation patterns [3]. To avoid dangerous anthropogenic interference, the climate policy debate has focused on limiting the average global temperature rise to an average of 1.5–2°C over pre-industrial times. Current models predict extreme weather events and biophysical impacts of greater magnitude for a global warming of 2°C than 1.5°C, but severe uncertainties in the range of impacts limit regional risk assessments [4]. In any scenario, probabilistic risk assessments based on coupled climate-carbon cycle models show that dangerous interference with the climate system can only be avoided if the climate response goes beyond pure carbon neutrality and results in persistent net negative emissions from reductions. CO_2 emissions in the atmosphere [5].

Recent long-term studies and meta-analyzes show that combined organic and inorganic fertilizers have a significant effect on soil carbon sequestration. The use of nitrogen has a stimulating effect on carbon preservation, including the decomposition of organic matter, a decrease in the carbon distribution profile of the root mass and mycorrhiza, the placement of carbon in various organic fractions of the soil, the microbial composition and activity of suppressing heterotrophic respiration, etc.

The use of lime in herbal ecosystems in the Chechen Republic can have a neutral or positive effect on soil carbon stocks. In addition to the potential effect of fertilization on carbon storage in the soil, the frequency and intensity of use of grasses is of key importance. With intensive grazing, about 25–40% of the consumed but not digested biomass returns to the pasture in the form of excrement [6].

Even when more than 80% of ground produce is harvested under intensive mowing conditions for hay or silage, carbon losses can be offset by the use of manure. The intensity of using herbs depends not only on the return of carbon and nitrogen to the soil, but also on the effect of photosynthetic capacity and carbon decomposition of plants in plant communities. In addition, the intensity of harvesting is reflected in soil-plant relationships, affecting the volume and quality of root residues and, thereby, the volume of organic matter and carbon in the soil of the Chechen Republic (Fig. 1) [7].

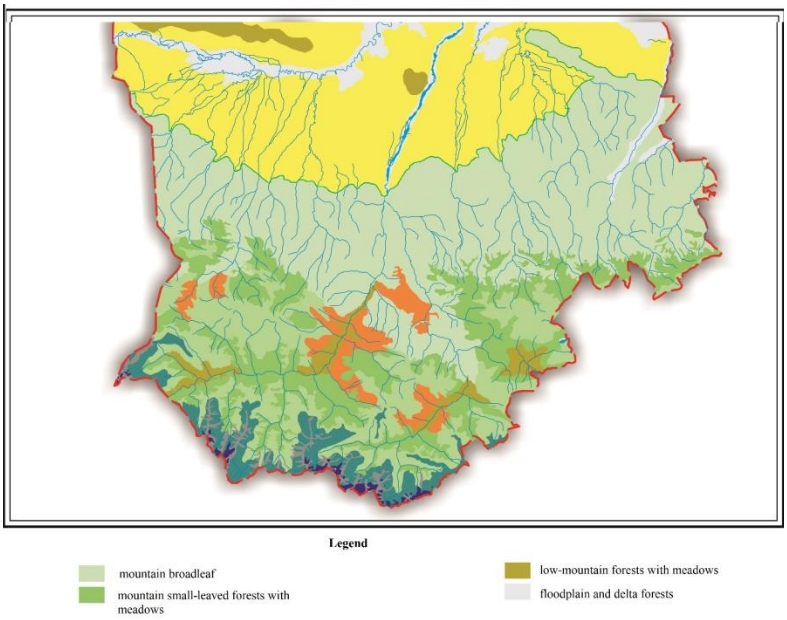

Figure 1: *Distribution of the main forest resources of the Chechen Republic*

For this reason, the intensive use of herbal biomass reduces carbon sequestration. The duration of the biomass produced and its quality are reflected in the sequestration of soil carbon. Plowing grasses in crop rotations leads to a decrease in soil carbon. Tillage has a significant impact on nutrient content and soil mineralization processes.

Natural climate solutions have been proposed as a way to achieve effective reductions in CO_2 emissions. Recent estimates indicate that NCS can provide more than one-third of the costeffective climate change mitigation required to stabilize warming below 2°C through 2030. Current NCS techniques consist of conserving, restoring and managing natural areas to increase land-based carbon stocks, which are an easy-to-implement way to reduce CO_2 emissions while providing a range of co-occurring socio-economic and environmental benefits (5–8). However, there is a critical and growing gap between the development of scientific knowledge and practical implementation at the required pace and scale. At a practical level, the methods for implementing CO_2 reduction initiatives are poorly defined, as best practices are sector-specific and highly dependent on the individual characteristics of the ecosystem [6].

For example, current practices include afforestation, reforestation and forestry; zero tillage and other farming methods; wetlands and other blue carbon recovery projects; and sustainable cropping or grazing on rangelands. However, most of the NCS research involves oversimplified landscapes and hypothetical participants, while real-world solutions involve space constraints, ownership difficulties, and limited resources. Dangerous human interventions can be prevented while improving human conditions through coordinated carbon sequestration, biodiversity conservation and action for social equity. [7] However, the gap between basic science and mitigation strategies still needs to be bridged for rapid implementation on the ground in heterogeneous landscapes.

The ability of managed and natural ecosystems to remove CO_2 from the atmosphere is limited by the laws of physics and ecological processes that govern photosynthesis and the breakdown of organic matter. In general, the rate and amount of carbon sequestration through NCS is slow and low compared to the rate and amount of CO_2 released from burning fossil fuels (9). Consequently, five principles have been proposed as a general framework for identifying significant CO_2 reduction requirements in the context of the broad demand for atmospheric restoration [8]:

1. Increasing carbon stocks in large landscapes requires quantifying baselines and predicting carbon storage potential based on geography, land-use sector, land cover and soil resources.

2. Efforts to reduce CO_2 emissions will require additional resources (eg water and nutrients). Minimizing these costs is critical to increasing long term carbon sequestration.

3. Large areas are needed for ecosystems that reduce anthropogenic CO_2 emissions. Public-private partnerships are critical to identifying and allocating land for long-term carbon storage.

4. The carbon sequestration potential of landscapes depends on their ability to serve as permanent carbon sinks, which varies from region to region depending on socio-economic and environmental factors.

5. Net CO_2 emission reductions are low compared to those from forest fires and land use practices. Thus, reducing emissions in the landscape is as important as accelerating carbon sequestration [9].

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