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Methodology for Risk Assessment of Climate Projects for Sustainable Development of the Forest Fund

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Abstract: This article assesses the potential of climate projects for sustainable forest development. The process of evaluating climate initiatives aimed at maintaining the long-term well-being of forest resources is highlighted in this publication. The article analyzes key methods of defining climate projects, describes financial sources and methods of their implementation, and identifies specific aspects of assessing the potential of such projects. Competent management of climate threats based on the application of climate and hydrometeorological data becomes particularly relevant in the present-day conditions. Special attention is paid to the importance of climatological support for preventive adaptation to long-term climate change. The integration of climate aspects with economic approaches aimed at obtaining accurate data on how vulnerable and at risk various actors are. Realizing these objectives requires close collaboration between experts from a variety of fields. For risk oversight and selection of the most effective management methods, the authors have developed risk maps, which is an effective tool for quick and compact demonstration of enterprise risk factors that interfere with the achievement of its strategic objectives, which has already proven its effectiveness in international financial control practices.

1 INTRODUCTION

Climate change on our planet has occurred repeatedly throughout history. Rapid and devastating changes in climatic conditions do not last long for most creatures. A prolonged period of calm then ensues, during which surviving organisms adapt to the new environment. Recently, climate change has led to a significant decline in global production of many agricultural crops, including grains. This phenomenon was previously characteristic of Africa, but is now increasingly affecting other regions, including Western Europe and the United States. Rising temperatures are also affecting the important aquaculture industry. With the world's population growing rapidly, the continuation of these trends could lead to a global food crisis. The problem is being addressed by importing food to regions that cannot feed themselves in the new climate. (Bezrukova T L et al., 2017).

Thus, a key approach to addressing global climate change may be the development of measures aimed at minimizing losses during the transition of humanity and natural systems to a new sustainable climate regime, as well as facilitating population adaptation to new conditions and preserving biodiversity. In the fight against climate change, which continues in various parts of the world despite global changes, the need to develop methodologies for assessing the effectiveness of climate initiatives is becoming more pressing (Leopold C et al., 2012). Achieving carbon neutrality is a strategic goal for Russia. Achieving this goal depends largely on the quality of cooperation between government agencies and businesses in reducing greenhouse gas emissions and attracting investment in the green economy (Van Bommel H W et al., 2011, Rao P et al., 2005).

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Climate change on Earth, primarily caused by the significant accumulation of greenhouse gases in the atmosphere, can lead to irreversible environmental consequences. To avoid these catastrophes, the global community has reached agreements to reduce the impact of human activity on the atmosphere and achieve carbon neutrality. The enhancement of the greenhouse effect, caused by the increase in carbon dioxide (CO2) concentrations in the atmosphere, is mainly due to the use of fossil fuels and methane leaks during the extraction, transportation, and distribution of oil and gas. In general, measures must be taken to reduce greenhouse gas emissions and transition to a more sustainable, low-carbon economy to prevent the irreversible environmental consequences of climate change. To this end, various mechanisms for reducing greenhouse gas emissions are being developed and implemented both at the level of international organizations and at the level of individual countries. In the process of transition to a sustainable, low-carbon economy, companies must assess and manage their carbon footprint to improve the competitiveness of their products (Seuring S et al., 2006, Bezrukova T L et al., 2018). Observational data and scientific research indicate that the acceleration of global warming in recent decades is associated with human activity.

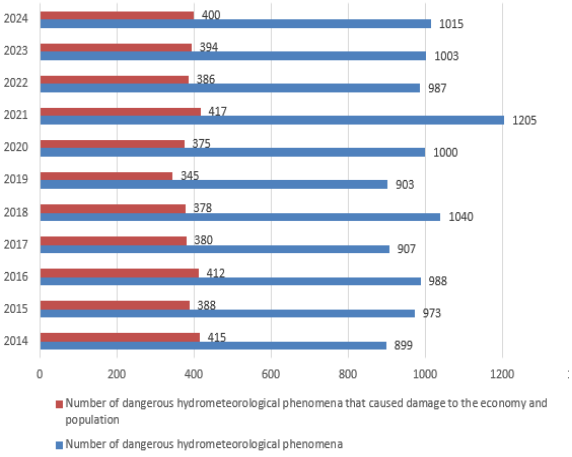

Figure 1: Analysis of hazards that have caused significant damage to the economy and livelihoods of the population.

The impact of climate conditions on the path to long-term societal progress is becoming increasingly significant. According to the World Economic Forum's 2020 Global Threat Assessment Report, extreme weather events rank first in terms of likelihood of occurrence, and climate change ranks first in terms of potential impact. In an era of globalization and integration of logistics processes between companies in different countries, the impact of weather events is starting to set off a chain reaction. One of the key ways emergency risks are embodied is through extreme events. Their number between 2020 and 2024 ranges from 760 to 1,205 events, peaking in 2021 (Denis-Papin M et al., 1984, Markowski-Lindsay M et al., 2020) The increase in the total number of emergency events in 2024 compared to 2020 is 21%, and the increase in events causing significant harm to the economy and people's livelihoods reaches 12%. There is a noticeable increase in the number of events causing damage to the economy and people's lives.

The discussion topic deals with issues related to transforming climatic conditions with significant impacts on climate projects. Particular attention is given to climate hazards related to physical impacts on engineering structures during the design and implementation phases (Bonilla-Bedoya S et al., 2020). Given the lack of complete and accurate climate data, it is recommended that information be obtained directly from climate project developers for analysis. In addition, it is suggested to collect information that will help to assess both climate and environmental risks, as in practice organizations approach this issue in an integrated manner. Analyzing absolute indicators makes it possible to assess the effectiveness of measures taken to reduce negative environmental impacts. Information on the availability of specific quantitative targets demonstrates the seriousness of intentions to implement measures to reduce climate risks in projects (Ludvig A et al., 2018, Wu X et al., 2019, Gingrich S et al., 2018). The authors propose a methodological approach based on the application of specialized climatic criteria that are important for objects and processes existing in the ecosystem. Regulatory documents developed for different spheres of economic activity specify climatic indicators to be taken into account when designing climate projects.

2 METHODOLOGY

Climate initiatives represent a variety of measures aimed at reducing the risks associated with climate change on Earth. These measures include various actions aimed at either reducing or absorbing greenhouse gas emissions. In this study, we examine methods for planning and implementing climate projects that contribute to a reduction in greenhouse gas concentrations in the atmosphere. The article will examine the definition and classification of climate projects, assess their potential, and analyze statistical data (Bonilla-Bedoya S et al., 2020). However, the

implementation of technology projects requires significant investment from companies due to the high cost of low-carbon technologies and insufficient demand for them. Currently, 52 climate initiatives are active in our country. Many similar projects are in the development stage, demonstrating significant interest from the business community in environmental climate initiatives. In Russia, despite the high cost and limited demand, the implementation of these projects is complicated by the lack of government measures to regulate carbon in the area of climate initiatives. Climate initiatives offer prospects for reducing greenhouse gas emissions, increasing energy efficiency, and countering the effects of global warming. More than 400 such projects have already been implemented worldwide, and they are operating successfully in the market. The development of the international carbon market began in 2005 after the entry into force of the Kyoto Protocol, which established certain limits on greenhouse gas emissions for developed countries and countries with economies in transition. The Kyoto Protocol also proposed flexible mechanisms for cooperation between countries, including international emissions trading, the Clean Development Mechanism, and joint implementation of emission reduction projects. Most of these projects are related to reforestation (Raymbaev C, et al., 2017).

By November 2024, Russia's estimated total climate project potential is 84.7 million carbon units, of which 32.5 million have already been put into circulation. As part of the country's sustainable low-carbon development strategy, Russia has announced its intention to achieve carbon neutrality by 2060 under the intensive scenario. To achieve this goal, it plans to reduce emissions by 15% by 2050 compared to 2019 levels (from 67% to 58% of emissions, excluding CO2 absorption in 1990). Forests are expected to offset approximately 65% of all emissions by 2050. By 2050, it is planned to reduce the difference between carbon emissions and removals by about 20 percent compared to 1990, but the road to complete carbon neutrality by 2060 remains unclear. Technologically, achieving this level of sequestration is possible, but it will require significant efforts to control forest fires and logging, proper forest management, and protection and restoration of primary forests. Forest climate projects have significant potential to address the problem of increasing atmospheric carbon sequestration and to be able to generate business profits. But in order to launch this industry in Russia, it is necessary to create favorable conditions and overcome a number of obstacles. It can assess climate risks based on criteria such as (de Mello N G R, et al., 2018).

• regulatory impact: the extent to which a project is directly affected by climate regulation;

• preference change impact: the extent to which a project may be affected by changes in society's preferences for the use of carbon-intensive products;

• transfer impact: the extent to which a project's climate risk may be transferred to the financial institution financing the project.

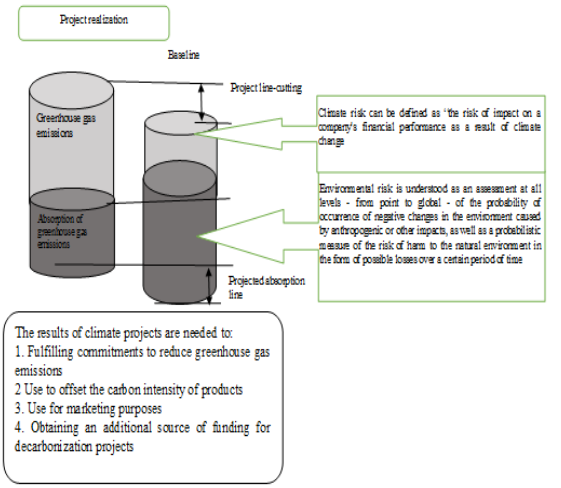

Figure 2: Potential for problems resulting from climate risks.

Projects aimed at reducing greenhouse gas emissions or improving their absorption, which leads to a change in the conditions defined in the baseline scenario, are called climate projects. To adequately assess the risks associated with climate projects focused on sustainable forest development, it is necessary to rely on generally accepted risk management principles. To obtain a complete understanding of climate risks using quantitative indicators, issues related to the development of appropriate documentation and the collection of information to create project vulnerability curves should be addressed (Gromov V.V., 2023). Responsible bodies should lead the implementation of the organization's climate strategy, bearing responsibility for the implementation of climate risk management practices and their integration into operational and business processes. Policies aimed at reducing climate risks (e.g., modernizing equipment to reduce the carbon footprint of products), as well as technological innovations (including the use of carbon capture, storage, and use technologies) require significant capital investments and additional investments for the implementation of climate projects. The baseline scenario is a projection of

greenhouse gas emissions in relative and absolute terms that, with an acceptable probability, reflects the trend in anthropogenic greenhouse gas emissions from emission sources that would exist in the absence of the project and is calculated for the entire life cycle of the project (Figure 2) (Suzdaleva A.L., 2023). Climate policy reform, including measures such as the introduction of an emissions trading system, may lead to a reduction in revenues and the need for additional investments to reduce the carbon footprint of products. Technological innovations, including the safe application of carbon sequestration, storage, and use methods, or the development of inexpensive renewable energy sources, can cause fundamental changes that require additional financial investments.

Changes in customer preferences may adversely impact companies' cash flows and require additional investments to implement climate strategies aimed at mitigating transition risks. The project model represents a forecast of relative and absolute greenhouse gas emissions, which, with a high probability, reflects the dynamics of anthropogenic emissions from sources associated with the project's implementation and is calculated for its entire life cycle (Figure 2) (Suzdaleva A.L., 2023).

3 RESULTS

The paper by Sassen, Hinze, and Hardeck (Sassen R.. et al., 2016) takes a similar approach, analyzing regression models with the inclusion of fixed effects. The outcome measure is the organization's financial risk, and the explanatory factor is the company's level of environmental impact, measured on a scale of 0 to 1 and drawn from the Thomson Reuters Asset database (Thomson, 2009). The authors find that this measure of influence is exclusively related to asset-specific risk, with no relationship observed between overall risk and environmental performance. The researchers scrutinize the presence of two-way causality, which is one of the strengths of their work, but they do not consider the use of exogenous instrumental variables that could confirm the absence of such a relationship. In addition, the study only covers European companies, which is a limitation of the study.

In creating a methodology for assessing climate-related risks for sustainable forestry, the methodology is based on statistical data, meteorological records, results of hydrodynamic analysis and other sources of information. The process of collecting information on the direct and indirect impact of climate factors on the organization's activities requires the use of both open data from partners on exposure to climate risks and specialized questionnaires for the financial company's counterparties.

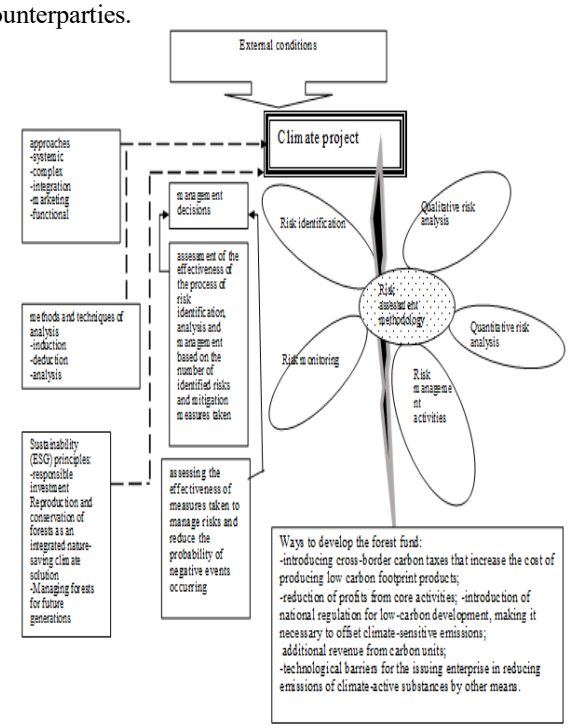

Figure 3: Methodology for risk assessment of climate projects.

It is recommended to use risk maps to control risks and select optimal methods of their management. This tool allows for a visual representation of the organization's business risks that hinder the achievement of strategic goals, and has found its recognition in the international practice of financial management (Semyonov S.Y 2023). Climate risks have unique features that may necessitate new approaches to their effective management. Analysis of changes in absolute indicators obtained by the expert method makes it possible to assess the effectiveness of measures taken to minimize the negative impact of climatic conditions on projects (Fomenko G.A., et al., 2022).

The information base for risk analysis includes the company's financial statements, its organizational structure and personnel deployment, process flow diagrams (production-related risks), contract documentation (commercial and legal risks), product production costs, strategic development plans, and external environmental data, such as market dynamics, trends, and the competitive environment. The risk assessment process is divided into two main stages: qualitative and quantitative. Qualitative analysis aims to identify risk sources and causes, as well as to determine specific stages and operations

during which risks may arise. This includes: identifying potentially hazardous areas; identifying risks specific to the company's operations; and assessing the potential benefits and possible negative consequences that may arise if risks materialize. To gather ideas related to project risks, an expert survey method is used, which involves preparing a list of questions. The responses received from the experts are then analyzed, classified, and returned to the participants for additional comments. A final consensus and a complete list of risks are formed after several iterations of this process. The Delphi method eliminates group pressure and fear of judgment when putting forward ideas, allowing each expert to work individually. The expert group, consisting of seven to ten people, includes specialists from various fields, such as rating agency analysts, environmental activists, investors, and consultants. Each expert independently, without prior discussion, compiles a list of the risks they perceive in the project. This is followed by a collective discussion of all identified risks and their subsequent individual ranking according to significance. The final step is to prioritize each risk and assign weights reflecting their contribution to the overall project risk. The highest weighting is assigned to key threats, while the lowest weighting is applied to the lowest-ranking risks. Risks of equal importance receive identical weightings. Each risk category has its own unique weighting scale.

Although numerous scientific studies have already confirmed the importance of studying climate threats, a full understanding of the consequences of this process remains elusive. Climate change is a complex and dynamic process whose consequences are varied and difficult to assess in the context of societal well-being. In this context, a comprehensive study of the potential impact of climate change on the economic environment, including the geographic distribution of production capacity, is particularly relevant. Particular attention is paid to climate-sensitive economic sectors such as forestry.

The study of climate risks that may affect the sustainability of forestry includes an analysis of the consequences of changing climate conditions. The link between global warming and economic processes has led to the development of integrated assessment models that employ an interdisciplinary approach to studying cause-and-effect relationships in the natural environment. Such integrated assessment models are used in various fields, helping to build reliable forecasts, assess the costs and benefits of various policy decisions, and analyze the uncertainties associated with various scenarios and strategies. They are also used to assess the impact of reducing uncertainty in key parameters and to determine the cost of research and development of new technologies. One example of such a model is DICE (Dynamic Climate and Economy), developed by W. Nordhaus. An expanded version of the DICE economic model is the Regional Integrated Climate and Economy Model (RICE), which details economic and climate interactions by dividing the world into 12 major regions.

This model analyzes key economic and demographic parameters, including production volumes, population, greenhouse gas emissions, and associated losses. In the context of Russian forest policy aimed at minimizing the impacts of global climate change, a key focus should be the creation of an effective and sustainable forest management system. This will increase the capacity of forests to absorb carbon dioxide. It is also important to focus efforts on changing the composition of forest species to achieve this goal. Forests play a vital role in the socioeconomic and environmental well-being of society, performing numerous functions. However, their ability to perform these functions is influenced by various factors, including annual anthropogenic impacts and climate change. The impact of climate variables on forest ecosystems is complex and can be assessed both qualitatively and quantitatively. To assess climate change risks and their impact on the sustainable development of the forest sector, a comprehensive system of indicators is necessary. This approach should consider the interests of all parties involved in climate projects and allow for an assessment of the overall effectiveness of investments. It is important to include indicators that reflect both the external and internal effects of the project. This will allow not only for a comprehensive assessment of climate initiatives but also for identifying the contribution of each participant to overall effectiveness. Unlike traditional evaluation methods, which focus on the performance of individual project implementers, this approach provides a more comprehensive understanding of the results.

After thoroughly investigating potential hazards and assessing the likelihood of their occurrence and level of impact, we will create a risk map for each project. This map will allow us to deeply analyze all identified hazards, their likelihood and magnitude of impact. This is critical for identifying the most relevant risks that require immediate action, which is a key aspect in implementing projects that aim to conserve climate and ensure a sustainable future for forest resources (Gardiner A., et al., 2015).

Table 1: Register of identified risks of climate projects.

Designation	Name of risk	Strength of influence	Probability, %

r1	Threat to human life and health, destruction of livelihoods, disruption of food and drinking water supplies	The event is more likely to not happen than to happen	5-20
r2	Groundwater depletion, reduced land productivity, rural migration	The event is more likely to happen than not to happen	50-80
r3	Risk of loss of specially protected species and ecosystems, ecosystem species mixing and increased dominance of invasive organisms.	The event may occur	20-50
r4	Risk of increased costs for elimination of environmental damage	The event is more likely to happen than not to happen	50-80
r5	Increased probability of forest fires	The event may occur	20-50
r6	Increase in the number of unfavorable weather conditions, change in temperature regime	The event will definitely happen	> 85
r7	Increase in precipitation and humidity	The event may occur	20-50
r8	New natural hazards	The event is more likely to not happen than to happen	5-20
r9	Risk of drought	It is extremely unlikely that the event could occur	<5
r10	Greenhouse effect	The event will definitely happen	> 85

The risk map is a powerful tool that helps select the best financial management approaches to match current market conditions. As the size of an enterprise increases, both the likelihood and the weight of different risks also change. This entails adjustments to financial management practices, but these practices are not always appropriate for the current market situation.

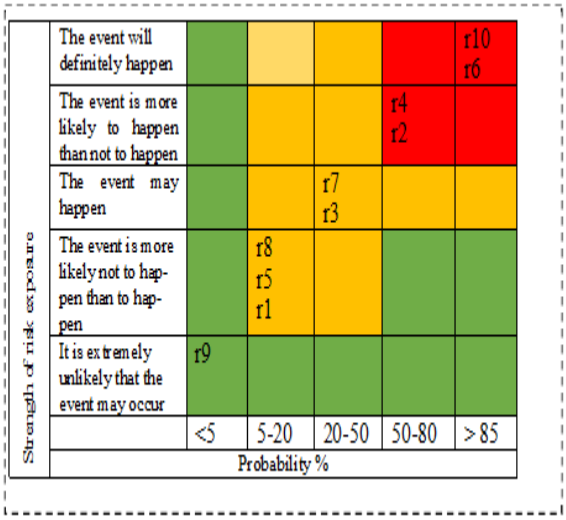

Figure 4: Climate project risk map

The importance of each of these factors is determined by specific objectives in risk management. When a manager identifies key issues, he or she needs to select an appropriate or group of appropriate methods to address them: either eliminate the problem, optimize costs, use a combination or separation, or transfer the risk to third parties through insurance.

4 CONCLUSIONS

Thus, the implementation of climate projects around the world demonstrates the interest of countries and businesses in reducing greenhouse gas emissions and preventing climate change. Natural climate projects, including ecosystem protection, biodiversity conservation, and reforestation, are the most popular. Technological climate projects related to the development of low-carbon energy, carbon capture and storage, and efficient waste management are less common due to their high cost and limited market presence. The introduction of legislation regulating the registration of climate projects demonstrates government interest and opens opportunities for Russian industrial enterprises to implement such initiatives.

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