Development of Socio-Ecological Systems: Climate, Ecology and General Trends

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Abstract. Recent world history has been marked by economic crises, environmental disasters, an increase in intrastate and interstate armed conflicts, as well as a heated confrontation in the field of energy resources. Among these risks, environmental problems such as rising global temperatures, rising sea levels, soil erosion, and shortages of food and minerals have become the most prominent. The safety of mankind and the environment is a value that in the XXI century. has acquired a global character and at the same time has become an urgent problem for the entire international community. Sustainable development, as one of the goals enshrined in the fundamental international legal documents, implies the conservation of the Earth's natural resources for the benefit of present and future generations.

1 Introduction

The global climate is determined by the global average temperature, which depends on the concentration of greenhouse gases (GHGs) in the atmosphere, which continue to rise. The key to addressing climate change is to reduce emissions and reduce GHG concentrations through removals. As part of the global climate agenda, a goal has been developed: to reach net-zero emissions in the second half of the 21st century (anthropogenic emissions should be equal to GHG removals) [1]. Currently, the climate policy of developed countries is undergoing a stage of major changes, and new energy technologies play the main role in this process. At the same time, the future of global energy and climate is increasingly dependent on decisions made in emerging market and developing countries. Emerging market and developing economies now account for more than two-thirds of global CO2 emissions, while emissions in advanced economies are declining structurally. At the same time, the upward trend in emissions will continue until active measures are taken to transform economic and energy systems. The trend could be reversed by a significant increase in investment in clean energy. To meet the stated goal of achieving zero net emissions in the second half of the 21st century, annual capital investment by 2030 must increase sevenfold, to over $1 trillion [2].

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The development of international legal acts of a universal nature for the conservation of the environment and the natural environment of the Earth was a natural stage in the development of international relations in this area [3]. Moreover, the term "greening of international relations" has confidently established itself in scientific circulation, which means the promotion of the importance of environmental aspects among the priority topics on the international agenda [6]. To date, two processes are developing in parallel: on the one hand, there is environmental degradation, which brings humanity closer to a global environmental catastrophe; on the other hand, the annual adoption of new international environmental treaties and agreements is unfolding, high-level meetings are held on environmental issues, and attention is being drawn to climate issues everywhere. The main problem is that the speed of global warming and its consequences exceeds the ability of social and economic systems to adapt to these changes. 2020 was one of the warmest years on record [7]. Climate risks increasingly affect global security as climate change leads to rising global temperatures, rising sea levels and many extreme events, including increased droughts and floods. Meanwhile, according to the International Federation of Red Cross and Red Crescent Societies, in 2021 the number of environmental refugees exceeded 30 million people worldwide [8]. The new UN report "Unity in Science" (2021) acknowledges that the world community is still far from achieving the goals enshrined in the 2015 Paris Climate Agreement [9]. The preface to the report published the opinion of UN Secretary-General António Guterres that in 2020, fossil fuel emissions have returned to their previous levels, greenhouse gas concentrations continue to rise and anthropogenic factors cause more and more destructive weather events that affect health , lives and livelihoods of people on all continents. On January 14, 2021, the international organization UNEP (United Nations Environment Program) published a report on shortcomings in the preparation and implementation of measures to adapt to climate change [10]. It is noted that these measures are very late, despite the fact that countries have moved forward in planning and implementing national actions. However, there are still significant challenges to be solved, especially in the area of financing developing countries and bringing adaptation projects to the point where they actually reduce climate risks. New and updated nationally determined contributions (NDCs) under the Paris Agreement by 2030 will reduce projected emissions by only 7. 5%, while 55% is needed to achieve the goal of the Paris Agreement to contain warming to 1.5 °C [12].

2 Research Methodology

The history of human-dominated socioecological systems is one of successive crises that were either successfully addressed, leading to sustainability, or not, leading to collapse, and the goal of studying history has always been to understand the past in order to understand and deal with the present and the future [4]. The assessment of the vulnerability of modern socioecological systems to future human activities and climate change can be greatly improved by (1) knowing the rates and directions of past trajectories in key processes, such as land cover, soil erosion, and flooding; (2) defining and analyzing how thresholds have been transgressed in the past; and (3) deducing the natural or pre-impact patterns of environmental variability [5]. Therefore, the past provides the means to test the models upon which we depend for future projections and scenarios [13]. The present nature and complexity of socioecological systems are heavily contingent on the past; we cannot fully appreciate the present condition without going back decades, centuries, or even millennia. The complexity theory, with related concepts such as nonlinear change, feedback and regime shifts, suggests that human activities and environmental change should be viewed together as a co-evolutionary and adaptive process [14]. Positive feedback loops may lead to a conditioning of landscapes that makes them more sensitive to new perturbations. Hence,

some historical societies, like those on Easter Island, became more prone to collapse through continuing resource depletion and ecological degradation. Others, such as the Akkadian society of Mesopotamia, became increasingly vulnerable to climate perturbations as their dependence on irrigated cultivation increased.

The Conference of Parties (COP) is the main supervisory body of the UNFCCC. It shall periodically review the fulfillment of the obligations of the Parties arising from the provisions of the Convention, as well as any related legal instruments; encourages and facilitates the exchange of information on measures taken in relation to climate change and makes, within its powers, the decisions necessary to promote the effective implementation of the Convention. In addition, the COP provides leadership in the development and periodic refinement of methodologies, for example, to assess the effectiveness of measures to limit the efficiency and increase the absorption of greenhouse gases, reviews, approves and publishes regular reports, makes recommendations on any issues of implementation of the UNFCCC, mobilizes financial resources [15]. One of the largest in recent times was the 25th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP-25), which was held in Madrid under the chairmanship of Chile. The outcome document, entitled “Time to act”, calls on participants to take urgent and comprehensive action in the field of environmental protection in order to implement the provisions of the Paris Agreement. Despite the fact that the UNFCCC is considered by all participants in the international community as a key international legal instrument to mitigate the consequences of anthropogenic impact on nature, COP-25 in Madrid 2019 failed to agree on common approaches to the implementation of market and non-market mechanisms of the Paris Agreement. The United States, European countries, China, India and a number of other countries have announced very ambitious and long-term goals in the field of combating climate change, caused primarily by anthropogenic industrial impact on nature - carbon emissions into the atmosphere [16]. National and regional strategies have emerged up to 2030–2070 aimed at effectively counteracting climate risks. At the same time, they declare not only a radical increase in environmental protection measures, but also the prospect of a global energy transition. In some countries, economic development projects based on alternative energy sources have been put forward or modernized: in Russia, for example, the idea of creating hydrogen energy has been proposed.

3 Results and Discussions

It is important to note that the adoption of the UNFCCC is of fundamental importance for the codification of international law in the field of climate change. This convention was the first comprehensive document fixing the obligations of states to preserve the Earth's climate. The UNFCCC is also of paramount importance in terms of creating an institutional framework for the operation of international environmental mechanisms. In addition, the Convention establishes the main directions of international climate policy, the principles of the activities of states and non-state actors, as well as procedural provisions in the field of preserving the Earth’s climate. However, this tool is often criticized. The UNFCCC as a framework convention contains only general principles and obligations. The Convention lacks specific mechanisms for fulfilling commitments, more detailed and intermediate goals, and time limits. The UNFCCC establishes only general rules, which, although they oblige states to act in a certain way, do not imply any mechanism for the implementation of these rules due to the absence of any enforcement mechanism. The adoption of the Kyoto Protocol (KP) in 1997 (entered into force in 2005) was a significant step forward, as this document specified the general provisions of the UNFCCC and established the numerical values of the obligations of states to reduce emissions. But it took a lot of time for the full launch of all the mechanisms provided for by the Kyoto channel. However, it should be noted that the low

support by the states of the Kyoto Protocol, along with non-compliance by the parties with certain provisions of the KP and targets to reduce greenhouse gas emissions, revealed the obvious need to adopt a new comprehensive document that would take into account and eliminate all of the above shortcomings. This agreement became the 2015 Paris Agreement (PS). The Paris Agreement was adopted at COP-21 [11]. The document consists of 29 articles and 16 preambular paragraphs that cover the main issues of adaptation to the effects of climate change and the means by which the objectives of the Convention are supposed to be achieved (capacity building, finance and technology transfer). The Paris Agreement is closely linked to the UNFCCC: in its operation it relies on the bodies and institutions established under the UNFCCC. The Conference of the Parties is also the platform for the meeting of the Parties to the Paris Agreement. For the first time, the Paris Agreement proposes to move away from the principle of common but differentiated responsibilities, fixing in the text of the document the obligation of all participants to make "ambitious efforts" [11], without dividing the responsibility of states depending on their level of development. The Paris Agreement sets out both individual and collective goals of the Parties. The main collective goal is to keep the increase in overall air temperature to no more than 2 degrees above pre-industrial levels and reinforce efforts to limit the increase in temperature to 1.5 degrees A, where the individual targets of the Parties have been included in the Annex (i.e. determined "from above –down"), the Parties to the Paris Agreement themselves determine their individual goals (i.e. "bottom-up"). Participating countries report nationally determined contributions to the global response to climate change (NDC). For example, parties can undertake activities to implement efforts to reduce emissions, technological upgrading and adaptation to climate change. The main drawback of the PS is the lack of the necessary mechanism for legal liability for violation of the provisions of the document. In addition, the Paris Agreement does not provide for the occurrence of any material consequences in the event of non-compliance with the NDC, despite the fact that this ensured the wide participation of countries in the PS. Therefore, it can be assumed that the Paris Agreement represents a compromise between the necessary measures and the actions that countries are ready to take. In turn, the International Energy According to the latest climate studies, until 2030, the world expects a temperature increase of at least 2.7 °C this century [6]. Nevertheless, the Paris Agreement remains a solid international legal framework for long-term climate change. A separate role is assigned to the importance of interstate dialogue to find answers to the environmental challenges of our time and responsible fulfillment of obligations under international agreements in this sphere. In addition, the central importance of the UN in shaping the international agenda both on climate issues and in the environmental sphere as a whole is consolidated. Climate issues should become a unifying factor for the international community, and an important role in achieving progress in this direction belongs to the UN and the leadership of the Organization. In addition, in 2015, the International Agenda for Sustainable Development up to 2030 was adopted [12]. Among the goals enshrined in the document, it is necessary to highlight goal 13 (actions to combat climate change), which emphasizes the urgency of taking measures to combat climate change and its consequences and notes that there is not a single country in the world that would not be affected by this problem. In light of the above, the great importance of the Paris Agreement is recognized, which represents the concerted will of the international community to start a joint fight against climate change. Analysts recognize the importance of the Paris Agreement, but many agree that we should not stop there, because one such step is not enough to solve most climate problems.

4 Conclusions

Climate change and extreme weather threaten human health and security, food, water and energy security, and the environment in Latin America and the Caribbean. According to a new World Meteorological Organization (WMO) report, The State of Climate in Latin America and the Caribbean 2020, the impacts are sweeping across the region, including the Andean peaks, river basins and numerous islands in the Caribbean. The report expresses particular concern about fires and the loss of forests, which are a vital carbon sink. The WMO report provides insight into the effects of rising temperatures, changing patterns of precipitation, storms and glacier retreat. It was launched on August 17, 2021 at the high-level conference "Working Together for Weather, Climate and Water Resilience in Latin America and the Caribbean" hosted by WMO, the United Nations Economic Commission for Latin America and the Caribbean (UNECLAC).) and the United Nations Office for Disaster Risk Reduction (UNISDR). This report follows the Intergovernmental Panel on Climate Change (IPCC) report "Climate Change 2021: The Physical Science Basis", which states that temperatures in this region have risen more than the global average and are likely to continue rise. It also predicts a radical change in precipitation patterns, further rise in sea levels, an increase in the number of floods in coastal areas, which, in turn, will affect all human systems and ecosystems. WMO Secretary-General Petteri Taalas states that Latin America and the Caribbean are among the regions most affected by extreme hydrometeorological events. Also increasingly visible are water and energy shortages, crop losses in agriculture, increased population migration rates, and widespread undermining of public health, all exacerbating the challenges posed by the COVID-19 pandemic. The current economic model of Latin America's development is based on the use and exploitation of its own raw material reserves. The ever-growing demand in the world market for mineral resources and agricultural raw materials has led to the fact that the extraction of minerals in most countries has become the most important factor in economic development. It is accompanied by enormous damage to the environment. As the most striking examples in the media, fires in the Amazon are mentioned, glaciers are melting in Patagonia, or dam breaks with numerous human casualties. Some researchers note the strengthening of the neo-extractivist concept in the economic development models of the countries of the region, which implies the over-exploitation of natural resources, increased mining, a hydrocarbon focus in the economy, and even large-scale deforestation. Such an approach, in turn, may lead in the future to an increase in social tension (including between the central government and representatives of the indigenous population, for whom the natural resources of the continent are of particular importance), aggravated climate and environmental changes, the growing economic vulnerability of the region and other risks. associated with disruption to agricultural production, food insecurity, ecosystem dysfunction and other unforeseen financial circumstances.

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