CLIMATE CHANGE STATISTICS – A RESPONSE TO THE CLIMATE CHALLENGES OF MODERN TIMES: THE EXPERIENCE OF THE KYRGYZ REPUBLIC

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Abstract

This article focuses on the development and implementation of a system of climate change statistical indicators in the Kyrgyz Republic. It discusses the methodological approaches and practical results of the first experience of creating a systematic set of climate change statistics and integrating them into national decision-making processes for climate adaptation in the Kyrgyz Republic.

Keywords: statistics, climate change indicators, climate change adaptation, climate risks

I. Introduction

Climate change is one of the defining challenges of this decade, with both direct and indirect impacts on key services and infrastructure that affect human well-being and the economy including healthcare, water supply and sanitation, construction, and electricity. Climate change poses an immediate physical risk to the very existence of a facility or region. For example, the destruction of a production site due to an extreme weather event increases the likelihood of a default by the operating company. Climate change also presents a significant financial risk. Climate adaptation measures, as well as global responses to climate threats (such as reducing greenhouse gas emissions and adaptation programs), can have far-reaching consequences for the structure and functioning of global and national economies and financial system [1].

Climate risk encompasses a range of hazards, from extreme weather events to long-term shifts in weather patterns. According to a report by the WMO, the number of natural disasters has increased by five times since 1970, while economic losses have risen even more – by seven times [2].

The situation is especially tense in Central Asia, where warming is occurring faster than the global average, and its rate has almost doubled compared to the period from 1961 to 1990. Record-high temperatures and dry conditions in the Eastern Himalayas and most of the Tien Shan region have accelerated the mass loss of many regional glaciers, which will soon limit access to drinking

and irrigation water, create problems in the hydropower sector, and affect agriculture. As the frequency of intense rainfall increases, mudslides and floods will become more common, while more frequent heatwaves will contribute to droughts and cause issues in the healthcare sector.

By 2050, Central Asia may see the emergence of 5 million climate migrants[1]. These climate-related risks exist alongside other challenges, such as misinformation, geopolitical competition, and inflation, and are key risks in 2024 and beyond[2]. It's also important to note that as the frequency and severity of natural disasters (e.g., floods, mudslides) increase, the costs of damage compensation continue to rise[3].

For these reasons, most countries (198 as of early 2022) have not only declared their willingness to adapt to climate change but also recognized the importance of achieving carbon neutrality. However, this progress has been slow and disproportionate to the growing climate risks. For instance, only 4.5% of countries have already achieved carbon neutrality, 10.6% have declared or committed to reaching carbon neutrality goals, 8.6% have enacted laws to achieve these goals, 29.3% have developed policies for achieving carbon neutrality, while the remaining 47% of countries are still discussing relevant documents [3].

The main reason for this situation is that climate risks are just one part of systemic risks. According to the UN Department of Economic and Social Affairs, if the transition to a zero-emissions economy is hastened without systemic changes (including in the field of information provision), the risks to financial stability could intensify [1].

These systemic consequences are essential to consider, as climate change is not an isolated issue – it has a substantial impact on all economic activities and efforts to ensure the well-being and quality of life for the population. The increasing climate risks require systemic changes across all areas of economic activity and the incorporation of climate concerns into national policies.

There is an urgent need for a new paradigm that combines traditional hydrometeorological research and data with climate adaptation studies, services, and assessments, reflected in national statistics. Given the importance of formalized government statistical data, the UN Department of Statistics even suggests that climate can be defined as the statistics of weather over a randomly determined period [1]. The value of reliable government statistical data becomes even more critical as the volume of fake news in the information space grows.

This article presents the methodological approaches and practical results of the first experience in developing a systematic set of reliable statistical data and integrating it into national climate adaptation decision-making processes in the Kyrgyz Republic[4].

II. Methodology

Modern climate management relies on accurate and accessible statistical and departmental data. The volume of climate data is growing exponentially due to the rapid expansion of both observation capabilities and computational power, driven by an improved understanding of climate processes, increased forecast accuracy, and advances in modeling.

Remote sensing data of the Earth's surface is also becoming more accessible for assessing long-term changes, complementing traditional climate observations and statistics (see Figure 1). Similar trends are observed in climate statistics, which have significantly expanded in recent years. Global sets of climate data and indicators, the UNECE set of climate change statistical indicators, the UN System of Environmental-Economic Accounting (SEEA) indicators, and international climate information databases are actively used.

[1] https://kun.uz/ru/news/2022/11/28/k-2050-godu-v-tsentralnoy-azii-poyavitsya-5-mln-klimaticheskix-migrantov.
[2] https://www.weforum.org/agenda/2024/01/climate-risks-are-finally-front-and-centre-of-the-global-consciousness/
[3] https://climatedata.imf.org/pages/adaptation#ad2.
[4] The research was carried out within the framework of the UNDP project "Promoting the process of developing a National Adaptation Plan (NAP) for medium-term and long-term planning and implementation of adaptation measures to climate change in the Kyrgyz Republic"

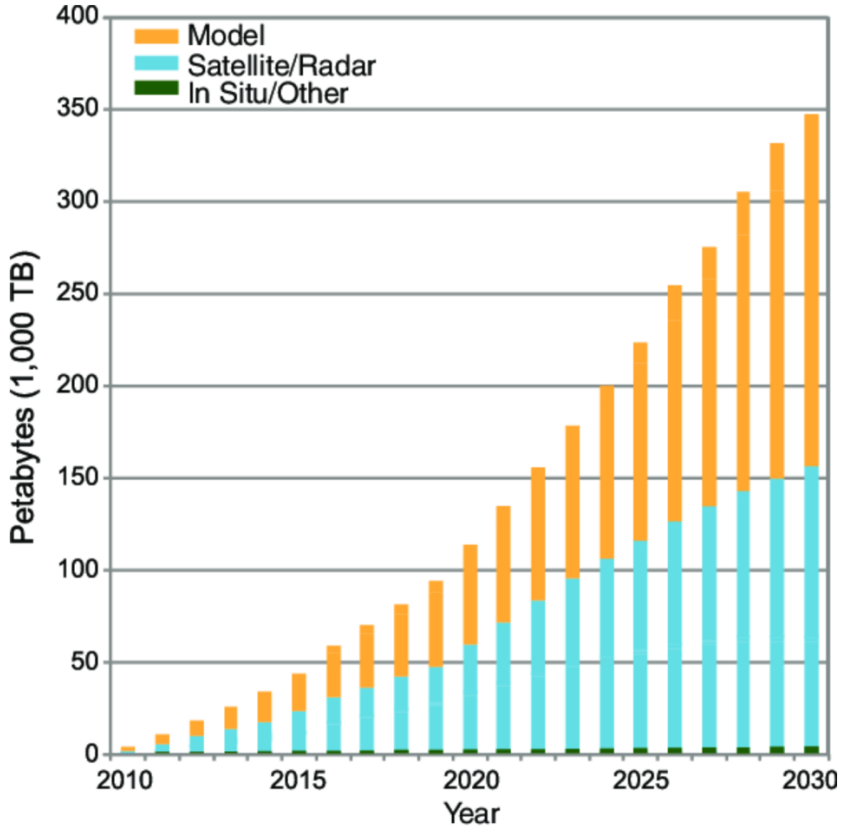

Figure 1: *Projected increase in global climate data for climate models, remote sensing data, and in situ instrumental/proxy data.*

Source: [4].

Understanding this, Infrastructure Panel (WIP) of the World Climate Research Programme (WCRP) and the Working Group on Climate Modeling (WGCM) were established 10 years ago. Their recommendations for global data infrastructure are based on several principles, starting with the need to separate requirements, implementation, and operations. Other important principles include considering the diverse needs of the data community (the data ecosystem), the importance of origin, the need for automation, and the commitment to measuring costs and benefits. WIP recommendations focus on requirements that take into account the diversity of the participating communities (model developers, analysts, software developers, and end-users). These requirements include the need for scientific reproducibility and accountability, as well as the need to register and track data usage. One key element is to focus on data sets rather than systems, aiming to make infrastructure less prone to systemic failures.

Despite this, climate data today are still full of gaps, hindering informed decision-making for managing climate risks. The rapid growth of global climate data also presents challenges in terms of physical archiving and sharing, as well as ease of access and search, especially for non-climate specialists.

A need for a new climate data paradigm is emerging in response to the constantly increasing volume of data, which should: (1) ensure free access to high-quality and reliable measurements for broad scientific research; (2) improve usefulness and clarity for a wide interdisciplinary audience; and (3) integrate climate risks into national and regional governance systems. Moreover, the channels through which climate shocks can be transmitted and amplified through the financial system are being actively studied [5].

In this new climate data paradigm, we believe that the focus should be on compressing

information and converting it into indicators that are understandable to policymakers, government specialists, businesses, and the general public. Furthermore, these indicators should ideally have the status of official statistics, as today's global information network is overwhelmed with false information (up to 60%), much of which is generated by bots (up to 40%) [6]. In addition to traditional statistics, "diagnostics," which is used to assess the nature of climate changes over various time scales, is also useful [7].

As a methodological platform for implementing climate statistics in public administration and risk management, it is advisable to adopt the standardized and internationally recognized System of Environmental-Economic Accounting and Ecosystem Accounting (SEEA-EA) [8], which is actively being implemented in national statistical systems worldwide. With its network and hierarchical structure, SEEA can serve as the core of a territorial climate change information system. It includes data on greenhouse gas emissions, the turnover of low-carbon technologies in the national economy, the carbon footprint of national products, the size and condition of various ecosystems and their vulnerabilities, the mitigation and adaptation functions of ecosystems, the impact of ecosystems on the national greenhouse gas balance, and more. Additionally, the Global Set of Climate Change Statistics and Indicators is largely (14% of indicators) composed of SEEA-EA-generated data, and the UNECE set of climate change statistical indicators is almost entirely (more than 60%) made up of SEEA-EA indicators. The SEEA-EA is also being developed in relation to the Classification of the Functions of Government[5]. Furthermore, harmonized climate measurements with the SEEA-EA have been developed in recent years under the G20 Data Gaps Initiative (DGI-3). This is expected to provide policymakers with an expanded toolkit for developing economic and financial policies to address climate change issues in conjunction with financial innovations and inclusive growth. Therefore, the UN SEEA-EA Standard [9-11] can set the basic requirements for the development and implementation of climate statistics in public administration and risk management to better represent opportunities for sustainable investment, innovation, and insurance in an unstable and changing external environment.

III. Results

The interdisciplinary research on the formation and strengthening of climate-related information support was conducted as part of the development of the National Adaptation Plan (NAP) for medium- and long-term planning and implementation of climate change adaptation measures in the Kyrgyz Republic, on assignment from the UNDP office in the Kyrgyz Republic. This research included methodological developments and practical steps to establish a broad system of climate services in the country and to build the capacity of two governmental bodies: the National Statistical Committee and the Hydrometeorological Service of the Kyrgyz Republic, both of which are authorized to produce and disseminate climate information with official state status. The findings of the research, as presented in this article, initiated the establishment of climate change statistics in the Kyrgyz Republic. The key events and outcomes of the Project can be considered as milestones in the development of national climate change statistics (see Figure 2).

[5] The Classification of Functions of Government (COFOG), developed by the OECD, categorizes government expenditure data from the System of National Accounts by the purpose for which the funds are used.

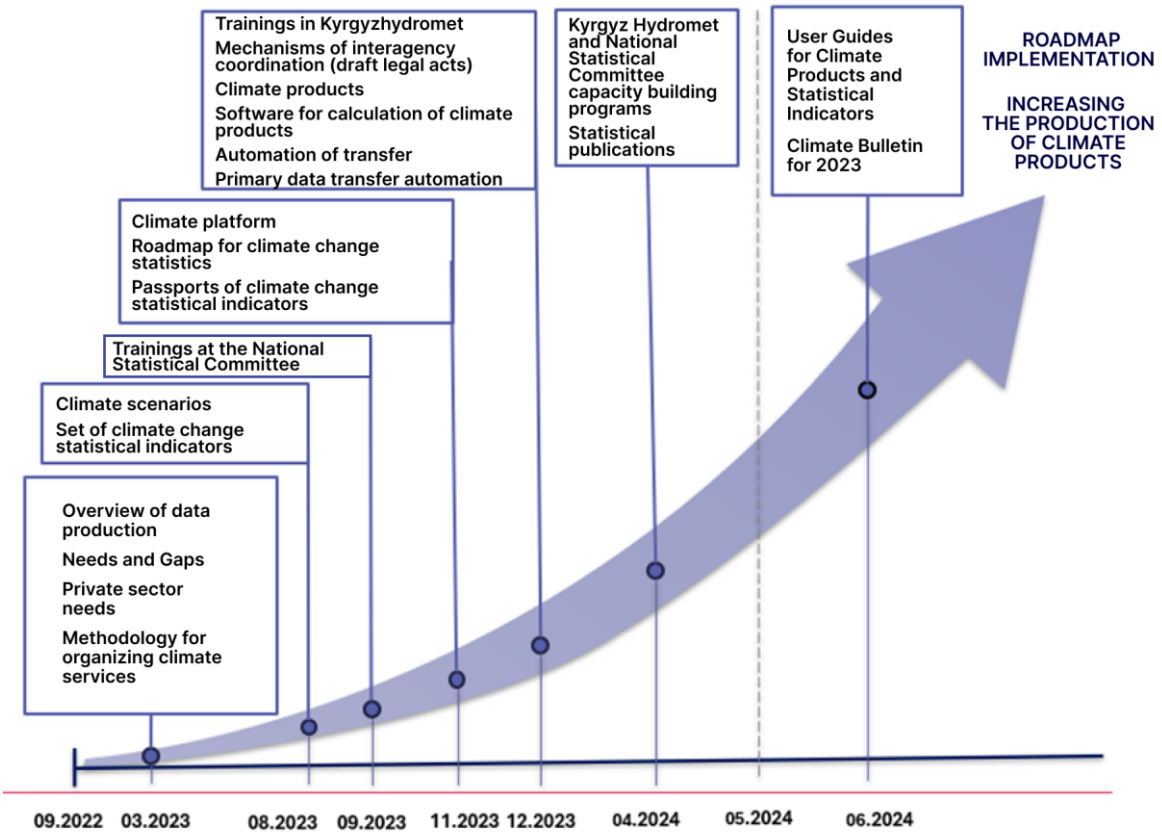

Figure 2: *The Process and Outcomes of the Project in the Establishment of New Climate Change Statistics in the Kyrgyz Republic*

Firstly, a significant characteristic of the Project was the development and implementation of a methodological approach aimed at effective planning that focuses on achieving specific outcomes[6] in improving the system of climate change statistical monitoring. This approach aims to increase the resilience of a wide range of stakeholders to climate change risks.

The systematic nature of the developed approach is defined by the complexity of climate change issues. The negative impacts and the risks they create affect the social, economic, environmental, and institutional aspects of sustainable development for regions and economic entities. An integrated "top-down" and "bottom-up" approach was implemented. Numerous meetings, trainings, and joint discussions identified the need to avoid the trap of system-bound analysis that relies solely on local knowledge, while also incorporating local institutional conditions, generational wisdom, and informal, socio-culturally driven factors and phenomena.

The research and decision-making were based on two planning principles: (1) an incremental approach, which is step-by-step progress, where decisions are made gradually as participants in discussions gather new information, and (2) a protective approach, prioritizing the interests of vulnerable and socially disadvantaged populations. Through mutual adaptation among stakeholders, actions were implemented progressively, considering all economic, environmental, social, political, cultural, and other conditions.

This methodological choice explains the significant number of interactive meetings involving the National Statistical Committee of the Kyrgyz Republic and the Hydrometeorological Service of the Kyrgyz Republic, with broad participation from government experts, members of the interagency working group on climate change indicators, and representatives from the real sector of the economy. These interdisciplinary discussions not only educated participants on the basics and specifics of climate statistics but also helped create indicators using the Global Set of Climate Change Statistics and other international recommendations. Over 500 people participated in 24

[6] The term “effective planning” currently refers to specific activities that lead to change [12].

training sessions, with more than 60% being women. The importance of women's traditionally strong role in Kyrgyz society and the need to formalize this role in public interactions were emphasized. Protecting the rights of rural widows to access water in conditions of water scarcity was also highlighted.

This approach enabled the gradual and multifaceted development of the set of climate change statistical indicators, their consideration by agencies and the private sector, and the formal development of each indicator and their metadata passports. As a result, by 2025, a significant portion of climate statistics will be published regularly. An important element of effective medium- and long-term planning was the creation of a Roadmap for the development of climate change statistics in the Kyrgyz Republic, which is essential for the successful introduction of new indicators into official statistics.

Secondly, a mechanism has been initiated in the Kyrgyz Republic for implementing climate change indicators within the institutional framework to enhance the resilience of climate-vulnerable sectors of the economy and a wide range of stakeholders to both current and future climate risks.

The availability of quality measurements for research and planning activities has improved, and the range of available hydrometeorological indicators has expanded. A new section in the official statistics of the Kyrgyz Republic has been developed – the "Climate Change Statistics" section, which includes 95 indicators grouped by specialized topics (drivers, impacts, vulnerability, mitigation, adaptation) and economic sectors (agriculture and irrigation, health, disaster risk management, biodiversity conservation and forestry, water management, urban areas, waste, industrial processes and product use, energy). This reflects various aspects of the climate agenda – hydrometeorological, environmental, socio-economic, demographic, and institutional. This is a foundational and pioneering step for many countries, not only in the development of official statistics but also in the national system of climate monitoring and services. Additionally, the project developed specialized climate indices and products. Before the project, only three hydrometeorological indicators were included in official statistics; now, there are 14.

As part of this project, research on current climate change and projections for the end of the century was conducted using two selected greenhouse gas emission scenarios, SSP5-8.5 and SSP2-4.5. Homogenized monthly temperature and precipitation data from 22 meteorological stations in Kyrgyzstan for the period 1980-2021 were used. Eleven climate products and methodologies for their calculation were developed to improve the quality of hydrometeorological data, and these were included in the national climate change statistical indicators by the National Statistical Committee of the Kyrgyz Republic. The basis for development was the WMO climate indices, which assess the impact of current climate and its changes on various socio-economic conditions in Kyrgyzstan. Climate products were calculated for the period 1980-2022 based on data from 13 meteorological stations in different climatic regions of Kyrgyzstan.

The development and first releases of the statistical publication "Climate Change Indicators in the Kyrgyz Republic" and the climate bulletin "Current State and Climate Change in the Kyrgyz Republic for 2023" will undoubtedly raise awareness among a wide range of stakeholders, with further editions planned on a regular basis. Additionally, two user manuals have been developed for the first time: a Climate Products User Manual and a Climate Change Statistical Indicators User Manual.

The priority focus is on expanding the understanding of climate vulnerability in the economic sectors of the Kyrgyz Republic. This ensures that a broad audience can comprehend the information and make relevant and rational decisions. During training presentations and open discussions, participants reflected on which physical climate threats hinder the development of vulnerable sectors and challenge public health and emergency systems. They were guided by an expanded understanding of the involved actors, considering the needs of government authorities, private sector representatives, and households. As a result, a set of statistical indicators was developed that covers a wide range of climate-related issues and phenomena, reducing climate vulnerability.

For example, despite data production challenges, the indicator "water reserves in glaciers"

was adopted. It was recognized that as glaciers are predicted to melt, water scarcity issues will intensify, both for the Kyrgyz Republic and neighboring Central Asian countries. A gender-inclusive indicator was adopted: "The proportion of the population without access to centralized life-support systems (water supply, heating, cooling), including persons with disabilities and households that have lost a male breadwinner."

It is also significant that as a result of the project, the skills of the National Statistical Committee and the Hydrometeorological Service of the Kyrgyz Republic in constructive interaction with users of climate information have been enhanced, including their ability to listen to real needs and willingness to develop in response to those needs.

To ensure the integration of climate risks into the management system of the Kyrgyz Republic, a set of measures on institutional, organizational, technical, and operational support was implemented. Institutionally, the following were prepared: (1) Proposals to amend regulatory and legal acts of the Kyrgyz Republic in the field of hydrometeorology and official statistics in terms of climate information production and provision; (2) Draft regulatory and legal acts to establish interagency coordination mechanisms; (3) A roadmap for improving climate change statistics in the Kyrgyz Republic; (4) Institutional mechanisms for interagency cooperation to develop a climate change statistical database in the Kyrgyz Republic and maximize the use of available statistical and departmental information resources.

Organizationally, the following were developed: (1) Proposals for changes to the structure of the Hydrometeorological Service's departments related to climate data and index production and provision; (2) Proposals for changes to the structure of the National Statistical Committee's departments related to climate data and index production and provision; (3) Long-term capacity-building programs for the National Statistical Committee and the Hydrometeorological Service of the Kyrgyz Republic, which were approved by the heads of these agencies.

Technically, the following were proposed: (1) Software and databases for calculating climate products (indices) for the Hydrometeorological Service of the Kyrgyz Republic; (2) Software for calculating climate products; (3) Databases for climate information production.

To institutionalize operational processes[7], the following were developed: (1) Recommendations for climate product production and climate change statistical indicator data production; (2) Guidelines for interagency coordination in producing official climate change statistics; (3) Materials for creating and maintaining a platform for interaction with the private sector.

Thirdly, a significant step was taken in developing a broad climate service system in the Kyrgyz Republic to increase the resilience of a wide range of stakeholders to climate risks and uncertainties.

For the first time in Central Asia, methodological recommendations were made for the development of a national climate service system, covering providers, mainly the National Statistical Committee and the Hydrometeorological Service of the Kyrgyz Republic, and a wide range of consumers (see Figure 3). Climate service is defined as the provision of climate information for making the best decisions by individuals and organizations. The focus was on the chain of climate information production and provision, viewed as the subject of climate service and integrating climate data[8] and climate products[9].

[7] In this case, an operational process is a regularly repeated sequence of activities that transforms primary data into climate indices and climate data that are made available to stakeholders.

[8] Climate data are historical and real-time climate observations and direct model outputs covering historical and future periods. All climate data should be accompanied by information on how these observational data and model outputs were derived (“metadata”)

[9] Climate products are summarized climate data. Products combine climate data with climate knowledge to enhance their value for adaptive management. Its use in the management process allows the climate factor to be adequately valued, thereby ensuring, as far as possible, that adaptive capacity is enhanced through climate informed decision-making [13].

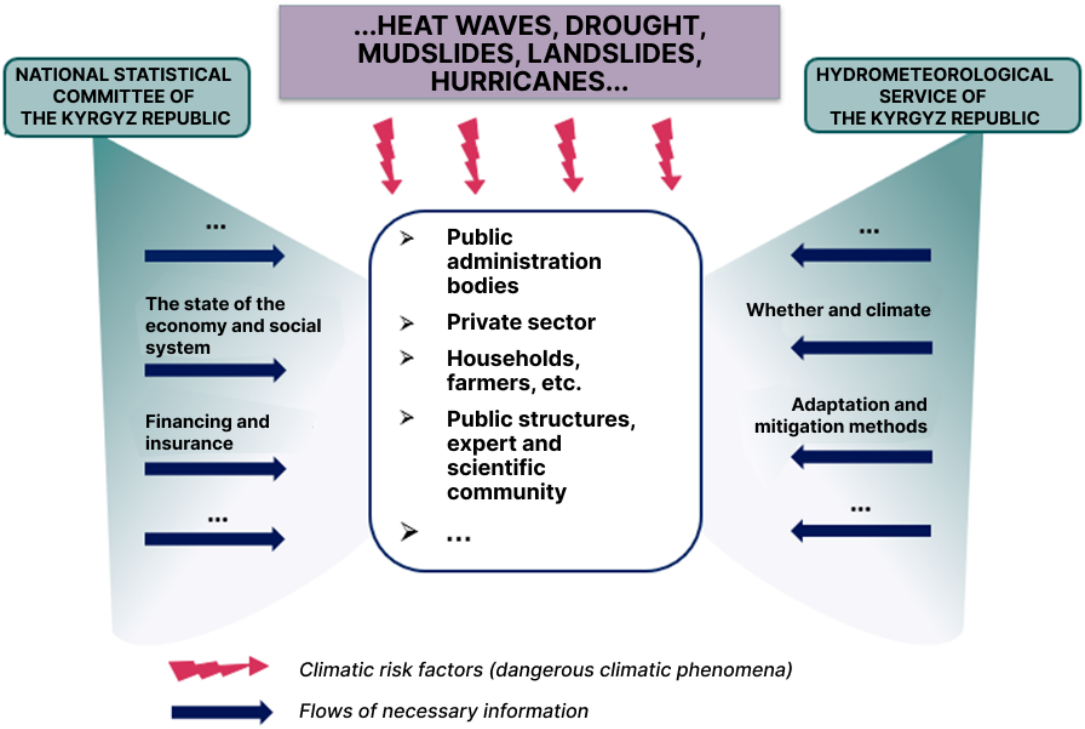

Figure 3: *Climate Service – A Necessary Factor for the Successful Implementation of the Climate Agenda of the Kyrgyz Republic*

A well-established and responsive climate service system creates the foundation for effective actions to reduce climate risks, adapt to climate change, and mitigate negative climate impacts. It is a broad yet targeted system addressing the problems and needs of a wide range of stakeholders. This includes diverse but crucial information – about weather and climate, past and future events, long-term trends, threats, and opportunities. This information is essential for making practical decisions regarding sector management, avoiding business losses, preventing threats to health and human life, and protecting material objects and infrastructure.

A significant focus during the project was on motivating and educating users about the relevance of climate information for various stakeholders – including specialists from territorial management bodies, sectors of the economy, representatives of large businesses and small producers, households, banks, credit organizations, insurance companies, public, and non-commercial entities. Each of these stakeholders has its own goals and perspectives on climate risks, but they all share a need for reliable and timely climate data.

All project activities were aimed at enhancing the capacity for producing and providing climate information by key climate service providers – the state agencies in meteorology and statistics. Their role as providers of reliable data is increasingly important in a world characterized by rising misinformation. The work of these agencies covers every link in the information production chain, including data collection, regular data processing, storage, provision, and the development and implementation of new climate indicators, all of which are legally and methodologically substantiated and supported by qualified personnel. Each stage of the process undergoes verification.

IV. Discussion

The climate agenda of the Kyrgyz Republic must be harmonized with global sustainable development goals (SDGs) and the overall systemic Concept of National Security of the country[10]. Defining and quantifying "climate change risk," with relevant measurement indicators, is central to analyzing development processes, as it is fundamental for assessing the socio-economic consequences of climate change. This, in turn, is crucial for planning effective, impactful, and fair climate adaptation and mitigation strategies. Extensive literature discusses the challenges, methods, results, and development of this fruitful research area, which has been evolving for nearly 40 years [14-18].

Today, the importance of creating effective climate statistics in every country is widely recognized. For example, in the Kyrgyz Republic, climate statistics have already been identified as a crucial and timely response to contemporary climate challenges. This significance is justified by the following premises:

- It is essential to improve the quality and availability of climate data, as the more we know about the climate crisis, the better we can identify and manage climate risks. Climate data will help analyze risks affecting the economy, monetary policy, price stability, and the financial system more effectively.
- The role of official government data needs to be strengthened; for instance, for the widespread adoption of climate insurance, which, according to UNDP, will become as significant as investments and innovations in the coming years.
- Transparency in climate-related issues must be ensured, and the quality of economic evaluation of targeted projects should be improved when transitioning to a green economy (cost-benefit analysis).

The special significance of the implemented project and its results lies in the initiation of a new trend in the development of statistics and meteorological support. The development of the indicator system and roadmap, and their integration into a unified statistical observation system in the Kyrgyz Republic, turned out to be a complex interdisciplinary and research-intensive task, as climate change impacts social, economic, environmental, and institutional aspects. Moreover, climate impacts are intertwined with increasing anthropogenic pressures on water, food, energy, biodiversity resources, inequality, and poverty.

The particular characteristic of the present time is that new concepts, terms, and institutions related to climate change and its impacts on various aspects of public life are becoming part of community and state life, expert discourse, official rhetoric, and decision-making systems. These are relatively new phenomena, yet climate challenges increasingly demand action, creating a need for new measurements and indicators. In this context, the project implemented comprehensive measures for institutional, organizational, technical, and operational support of new management actions within the climate agenda, ensuring that new "rules of the game" complement existing norms, rules, and practices without contradicting them. Thus, the following were ensured at each stage:

- Alignment with the needs of climate-vulnerable sectors and other stakeholders in the Kyrgyz Republic;
- Adherence to international recommendations and best practices;
- Consistency with existing local institutional and organizational conditions, including the ability to produce climate information and enable users to understand how to use it effectively.

Internationally, the project has localized the UN Global Statistical Indicators to the Kyrgyz

[10] Concept of National Security of the Kyrgyz Republic (Decree of the President of the Kyrgyz Republic of December 20, 2021 № 570).

Republic, adapting them to local needs and conditions for reducing climate risks and uncertainties. Each indicator has been developed with a metadata passport. Another significant result is the set of climate products developed with the help of international consultants on our project. Importantly, these climate products are included in the statistical set for the first time. This grants them high national status – at the level of official statistics, with regular production and publication of data, which undoubtedly indicates the systematic approach of the Kyrgyz Republic to assessing climate risks and threats, as well as to monitoring and transparency in climate actions. This represents an important innovative step in improving climate service formats.

V. Conclusions

The study of potential directions for the development and mechanisms of implementing climate change statistics in the Kyrgyz Republic, as an informational basis for reducing climate risks, led to several conclusions important both theoretically and practically.

Theoretically, with the increasing climate burden, defining and quantifying "climate change risk," as well as developing corresponding measurement indicators, is essential for analyzing the development processes of the Kyrgyz Republic. The reason is that without measuring risk reflection, planning climate risk reduction measures and conducting environmental and socio-economic assessments of climate change consequences are impossible.

The development of an adapted system of climate statistics indicators for the Kyrgyz Republic is the foundation for planning effective, impactful, and fair climate strategies (adaptation and mitigation). This indicator system should meet the basic requirements of the *new paradigm* of climate data in the context of growing volumes at global and national levels. The new system of climate change statistical indicators should: ensure free access to high-quality and reliable measurements for scientific research, enhance the utility and comprehensibility of climate information and data for a broad interdisciplinary audience, and integrate climate risks into country and regional management systems, covering a range of dangers from extreme weather events to long-term climate changes.

Since climate impacts affect systemic aspects of sustainable development, methodological approaches should combine "top-down" and "bottom-up" approaches, as well as incremental and protectionist approaches to planning.

Practically, new realities in the climate agenda in the Kyrgyz Republic, as in many other countries, involve increased demands and a transition to a new qualitative level for national statistical and meteorological services. These services are required to expand and strengthen their skills to provide adequate responses to new needs for reliable climate data, update their systematic scientific and calculation bases for producing climate data, and ensure regular publication. Enhancing the significance of these services on international platforms, such as the UN, WMO, and Eurostat, is also crucial. Such transformations will undoubtedly contribute to strengthening and substantively developing the Kyrgyz Republic's image as an active player in the international climate agenda.

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