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Central Asia's AFFAIRS 2/2021
QUARTERLY ANALYTICAL REVIEW

KAZISS
Kazakhstan Institute for Strategic Studies under the President of the Republic of Kazakhstan

Issued Quarterly Since 2003

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Translation by LLC «Delta Consulting Group»

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This Journal was registered
with the Ministry of Culture and Information
of the Republic of Kazakhstan
on January 24, 2003.
Registration certificate No. 3529-zh.

ISSN 2414-570X (print)
ISSN 2788-5909 (online)

doi.org/10.52536/CAA

Printed by «Nadegda 2050» LLP,
Kokshetau, Baimukanov street, 3.
Copies: 250

SRSTI:
11.25.67

TO THE QUESTION OF THE NECESSITY OF CREATING A NATIONAL PROJECT TO PREPARE CITIES FOR ADAPTATION IN THE CONDITIONS OF CLIMATE CHANGE

doi.org/10.52536/KS/vol_82_issue_2_A3

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Abstract. Climate change is a global problem that goes beyond the borders of countries, and in order to effectively meet its negative consequences, 197 countries of the world have united since 2015, including the Kyrgyz Republic. The world has become unpredictable with unexpected challenges of the time, like the coronavirus epidemic, its consequences in the form of economic and social instabilities. In the article about the forecasts that await the Kyrgyz Republic in the event of drastic climatic changes and the need to adopt national programs to prepare cities and villages for new challenges. The urgency of international cooperation in the form of joint expeditions, scientific research on the adaptation of cities and towns to the consequences of climate change is obvious, against the background of the projected shortage of resources. This topic will provide a solid foundation for cooperation that will guide global efforts in safe living, in the development of vectors of development over the next decades.

Key words: *Climate change, Sustainable Development, Green Urban Development, Eco-cities.*

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КЛИМАТТЫҚ ӨЗГЕРУ ЖАҒДАЙЫНДА ҚАЛАЛАРДЫ АДАПТАНУҒА ДАЙЫНДАУ ҮШІН ҰЛТТЫҚ ЖОБА ҚҰРУ ҚАЖЕТТІЛІГІ МӘСЕЛЕСІНЕ

Айгул Насирдинова

Аңдатпа. Климаттың өзгеруі - бұл елдердің шекарасынан шығатын жаһандық проблема және оның теріс салдарын тиімді жою үшін 2015 жылдан бастап әлемнің 197 елі, оның ішінде Қырғыз Республикасы да біріктірілді. Коронавирус эпидемиясы, оның экономикалық және әлеуметтік тұрақсыздық түріндегі салдары сияқты уақыттың күтпеген сын-қатерлеріне байланысты әлем болжанбайтын болды. Мақалада шұғыл климаттық өзгерістер кезінде Қырғызстанды күтетін болжамдар туралы, қалалар мен ауылдарды жаңа сынақтарға дайындау үшін ұлттық бағдарламалар қабылдау қажеттілігі туралы айтылады. Бірлескен экспедициялар түріндегі халықаралық ынтымақтастықтың өзектілігі, қалаларды климаттың өзгеру салдарына бейімдеу бойынша ғылыми зерттеулер ресурстардың жетіспейтіндігі аясында айқын көрінеді. Бұл тақырып алдағы онжылдықтардағы қауіпсіз өмірді қамтамасыз ету және даму векторларын қалыптастыру бойынша ғаламдық күш-жігерді бағыттайтын ынтымақтастықтың берік негізін қалады.

Түйін сөздер: *климаттың өзгеруі, тұрақты даму, жасыл қала құрылысы, экологиялық қалалар.*

К ВОПРОСУ О НЕОБХОДИМОСТИ СОЗДАНИЯ НАЦИОНАЛЬНОГО ПРОЕКТА ПО ПОДГОТОВКЕ ГОРОДОВ К АДАПТАЦИИ В УСЛОВИЯХ ИЗМЕНЕНИЯ КЛИМАТА

Айгул Насирдинова

Аннотация. Изменение климата - глобальная проблема, выходящая за пределы стран, и для эффективного устранения ее негативных последствий с 2015 года объединились 197 стран мира, в том числе Кыргызская Республика. Мир стал непредсказуемым из-за неожиданных вызовов времени, таких как эпидемия коронавируса, ее последствия в виде экономической и социальной нестабильности. В статье рассказывается о прогнозах, которые ждут Кыргызстан в случае резких климатических изменений, и о необходимости принятия национальных программ по подготовке городов и сел к новым вызовам. Актуальность международного сотрудничества в виде совместных экспедиций, научных исследований по адаптации городов к последствиям изменения климата очевидна на фоне прогнозируемого дефицита ресурсов. Эта тема обеспечит прочную основу для сотрудничества, которое будет направлять глобальные усилия по обеспечению безопасной жизнедеятельности и разработке векторов развития в течение следующих десятилетий.

Ключевые слова: *изменение климата, устойчивое развитие, зеленое градостроительство, экогорода.*

Introduction

The relevance of the article lies in the upcoming problems that can be expected in the country due to natural and climatic changes. The territory of the Kyrgyz Republic is 93% located in the highlands, where construction is limited due to high seismicity, unpredictable geophysics, geodynamics (mobile terrain) and lack of research. Of these, 7% of the territory is occupied by cities and settlements, as well as arable land being cultivated, gardens being planted, and new facilities being built. Only 20% of the territory is suitable for comfortable living.

Urbanization around the world is progressing at a rapid pace. It is predicted that growth is already leading to an exponentially high increase in resource intensity, and Kyrgyzstan significantly exceeded its average values in the region in 2016. *"Material resource intensity of Kyrgyzstan amounts to 7.9 kg/USD. This is almost four times higher than the ESCAP regional average of 2 kg/USD. These trends are similar to the intensity of energy and water use: the energy intensity of Kyrgyzstan (measured in kg of oil equivalent per USD 1,000 of GDP) equals 206.4 compared to the ESCAP average of 133.6, and the water intensity (measured in m3 per US dollar) in Kyrgyzstan is even more extreme and exceeds twenty times the ESCAP and sub-regional averages. Water capacity (in m3 per US dollar): the ESCAP average is 0.11, the average for the North and Central Asia sub-region is 0.11, while in Kyrgyzstan it is 2."*[1]. Consequently, trends in resource requirements and resource efficiency directly related to urbanization imply the regulation of the consumption of urban life support systems and the importance of actions related to their management, monitoring, accounting, and quality.

A city is an economic unit and a "living" organism with the intersection of multi-layered interests requiring systematic research, integrated solutions and synergistic thinking in the management, planning, design, and organization of territories. According to UN-Habitat, in 2013, cities, which account for about 55% of the world's total population, generated about 80% of the world's GDP. The World Bank report on Competitive Cities for Jobs and Growth: What, Who, and How shows that Baku (Azerbaijan), Almaty and Astana (Kazakhstan), Bishkek (Kyrgyzstan), and Tashkent (Uzbekistan) grew faster than their national economies from 2005 to 2012. In many cities around the world, the contribution of urban areas to national income is more significant than their share in the national contribution[2].

By 2050, the world's population will reach 10 billion people. The general problem will be the need for the resources such as water or healthy food sources, for which the lack of arable land is one of the urgent global problems that need to be addressed today. At the same time, there are obvious signs of irrational nature management - development through new land development, the use of natural resources and new construction - which usually occurs at a low scientific and technical level and leads to the impoverishment of natural resources. Clear examples are arable land and pastures that experience anthropogenic and climatic ecocide, and some facilities that are being constructed without taking into account the natural conditions of Kyrgyzstan. The territorial and spatial growth of cities and localities is going horizontally – they broaden at the expense of adjacent territories, previously massively occupied areas. There is no multi-factor assessment of the entire territory of the country, which was previously taken into account in the Soviet general schemes and projects of district (regional) planning.

The analysis of the strategic documents of the Kyrgyz Republic shows that various programs and projects were adopted to improve life in the country. In 2001, in order to stabilize the social and economic development of the republic, there was adopted the *State Concept for the Development of Small Towns and Urban-Type Settlements of the Kyrgyz Republic to equalize the disparity in development.* The transition to a new form of economic development and decentralized management in the result of the

restructuring of large industrial facilities as the main city-forming factors in all cities and urban-type settlements caused, first of all, the loss of jobs and a high level of unemployment, which led to a decrease in the standard of living of people, which in turn increased migration processes. The analytics of 2001 showed that in small towns of the republic there was a real danger of outbreaks of infections of certain diseases that belong to social ones, such as tuberculosis, brucellosis, intestinal infections, etc." After the "restructuring", the country is almost unable to "get up from its knees". In 2009, *the concept of the state regional policy* was approved in the Kyrgyz Republic, but for 2021, the disproportions in the growth of cities remained with 82% of rural localities remain subsidized. In 2017, the *concept of the regional policy of the Kyrgyz Republic for 2018-2022 was approved*. In 2013, "the priority directions of adaptation to climate change in the Kyrgyz Republic until 2017 were approved." Since 2016, the Kyrgyz Republic has become a member country of the global Partnership for Actions within the Green Economy (PAGE) initiative. In 2019, *the Program for the Green Economy Development in the Kyrgyz Republic for 2019-2023* was adopted, approved by Government Resolution No. 605 of November 14, 2019, in the Green City section of which it was proposed to develop sustainable green urban planning [3]. The Green Economy Program of the Kyrgyz Republic has identified seven priority areas: 1. Green energy; 2. Green agriculture; 3. Low-carbon and environmentally friendly transport; 4. Sustainable tourism; 5. Green industry; 6. Green cities[1]; 7. Waste management. Support for the transition to a green economy in the Kyrgyz Republic is provided through: 1. Sustainable financing; 2. Fiscal stimulation; 3. Sustainable public procurement. Program for the Green Economy Development of the Kyrgyz Republic for 2019-2023, in the part of action plans for the Green City section, introduced new concepts, terms, inclusive procedures and modern design methods as measures for implementation. Their implementation can significantly develop the city's policy to improve the management of cities. The implementation of the green cities (eco-cities) principles provides for improvement in the fields of planning, management, regulation of urban and regional territories. High-quality and safe development of the urban environment infrastructure will provide a stable system of factors aimed at identifying the potential for self-organization of cities [4] [5] [6] [7].

The concepts and strategies of the Green Country-Green Urban Development macro-system are also focused on the goals of sustainable development. Thus, *the object and subject of the research* are new models of cities, strategies and concepts of eco-cities, proposed by us for the identification of architecture and urban planning in the expected natural and climatic changes, where new approaches will be required in models of life arrangement, concepts of economy, urbanization, search for concepts of form and space of architecture, as well as in the design of lifestyle in mountains.

Research Methodology

The methodology of the research was determined by the source material of an interdisciplinary nature. The synergetic method is relevant for overcoming the fragmentation of modern science, for recreating a holistic vision of the Image of the World in enriching science with new concepts. The objects of the research are synergetic. It is proposed to reveal the abilities for self-organization and self-support of urban life support systems and to choose the concepts of sustainable development of eco-cities in the mountains in the conditions of climate change. The synergetic method allows for long-term forecasting. Currently, we use development scenarios in graphical, visualized models.

The analysis and comparison within the framework of this scientific direction of publications related to the problem under

[1] The results of our research, recommendations, goals and objectives, measures and solutions were implemented in the Green Economy Development Program in the Kyrgyz Republic for 2019-2023 in the green city section as the priority direction of the Government work (author's note).

consideration in order to identify signs are also recorded in the following procedures: 1. Summary analysis, drawing up diagrams, indicator matrices, summarizing the results of the research. 2. Forecasting and search for new values in architecture in line with the theory of "synergetics" based on the revealed patterns of object formation, in experimental projects. *The territorial boundaries* of the research are located in the Kyrgyz Republic.

Forecast of the future problems that can be expected in the territory of the Kyrgyz Republic in natural and climatic changes

The expected climate changes are going to be unfavourable for the national economy (primarily for agriculture), health of the population and natural ecosystems. The third National Communication of the Kyrgyz Republic on the UN Framework Convention on Climate Change [8, 57] revealed the following:

1. "Adaptation to climate change is a necessary element of action, since, given the volumes of greenhouse gas (GHG) already released, climate change will continue in the future under any emission scenario. In addition, the climate changes already observed require adaptation measures." The expected climate changes are going to be unfavourable for the national economy (primarily for agriculture), health of the population and natural ecosystems.

2. Inventory of anthropogenic emissions The total GHG emissions in 2010, taking into account the net emissions in the LULUCF[1] sector, decreased by more than 2 times and amounted to 13046 Gg of CO2-eq. compared to 28,712 Gg of CO2-eq. in 1990. After a sharp drop in 1990-1995 (coinciding with the shutdown of industrial enterprises), the total GHG emission for the Kyrgyz Republic slowly increased, but even in 2008-2010, it was significantly less than the level of 1990 values. The total GHG emission in 2010 is only 45.4% of the 1990 emission. For individual sectors, the decrease in emissions was: Energy – 66.8%, Industrial processes – 41.8%.

3. Distribution of total GHG emissions by region, excluding effluents, across all sectors With the exception of the "Solvent use" sector, where GHG emissions are absent, the most significant contribution to total GHG emissions is made by Bishkek (more than a third of all emissions) and two sectors of "Energy" and "Waste". Then there are Chui, Jalal-Abad, Osh, Batken, Issyk-Kul, Naryn, Osh and Talas regions. All regions are characterized by a significant contribution of the "Agriculture" sector, while the contribution of the "Industry" sector is significant only in the Chui region.

Other materials on the actual data are added to the above problems:

4. Theoretical and experimental results in the forecasts for *"global ecosystem thresholds due to aridity"* - the authors note that the increase in aridity is major in climate change and shall affect several components of the ecosystem, but it is necessary to find out whether these impacts will be gradual or abrupt [9]. Nonlinear changes in the ecosystem in response to processes such as grazing. Pressure or climate change forms the basis of the desertification theory and is usually demonstrated using mathematical models that predict the presence of single thresholds in certain structural attributes, such as vegetation cover or spatial structure. "The increase in aridity led to systemic and abrupt changes in most ecosystem attributes that occurred sequentially in three phases characterized by sharp declines in plant productivity, soil fertility, and vegetation cover/richness during aridity. (1 - dryness index) values of 0.54, 0.7 and 0.8." [9, p. 787].

It was established that the melting of glaciers is an irreversible process:

5. Forecasts for the state of glaciers to date, the glaciation area has decreased by 20%. By 2025, 30% of glaciers will be gone. By 2100, there will be no glaciers left. With such a negative scenario that change the natural and climatic conditions, flora and fauna, the economy will survive a severe blow.

[1] LULUCF - Land use, land-use change and forestry

6. Maps on risks like landslides, mudslides and flooding, breakthrough lakes, rockfalls and avalanches, etc. show small changes.

7. The territory of the Kyrgyz Republic is 93% of the mountain, where it is impossible to perform construction for seismic reasons, due to mobile reliefs and in conditions of unpredictable geophysics and non-exploration. Under unfavourable climatic scenarios, almost the entire territory of the republic occupied by arable land falls into the zone of deserts and semi-deserts, and with the melting of glaciers, floods will occur in 7% of the valleys where all cities and villages are built.

For example, on the territory of Kyrgyzstan there are 750 lakes, reservoirs and small ponds which occupy 3.4% of the territory of the republic. Out of these, 16 lakes and 11 reservoirs each have more than 1 km^2 of area. Mostly, the lakes are located in the alpine zone, at the end of the glaciers within the altitudes of 3000-4000 m. When the glaciers melt, they are potentially capable of flooding settlements.

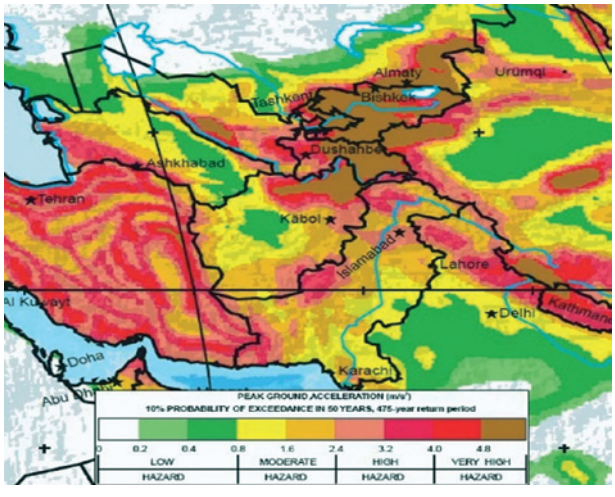

Figure 1. *A fragment of a map of the Earth's seismic characteristics. Almost the entire territory of the Kyrgyz Republic is located in the brown, most destructive zone.*

8. The life of capital construction of industrial, public, and residential facilities is 50 years, infrastructure goes for 30-40 years, and they all have reached their service life limits. The engineering infrastructure is 90% worn out [4]. There is a threat of man-made accidents.

9. During the Independence, the country has lost the position of an industrial country, moving to an agricultural and commercial type of management, and industrial, manufacturing enterprises have become small and account for 15%. Apart from water resources, mining, light industry and tourism, the main city-forming players are more than 10,000 small and medium-sized enterprises. Thus, the development of cities on an industrial basis is already problematic.

10. According to the National Statistical Committee, 72% of the population work in agriculture and commerce, which is also an indicator of self-employment. How will the quality of the social map change, will it be ready for the challenges of natural and climatic changes, will it become adaptive and sustainable to meet them?

11. The UN Environment Program with the support of the Austrian government, is implementing the project "Action to mitigate climate change in developing countries with vulnerable mountain ecosystems in a (sub) regional perspective". The project aims to support mountainous countries in five subregions (Central Asia, East Africa, South Caucasus, Tropical Andes, and Western Balkans) to integrate climate change adaptation issues into their respective development strategies, plans and programs. [10]. In this project, a ranking was made according to the current vulnerabilities to climate change in the CA region and the potential impacts of natural disasters (droughts, floods) which are among the constraints to sustainable development, such as: poverty, infrastructure development, energy, agriculture and food security.

In September 2019, the UN hosted a Climate Summit dedicated to the key areas "of greatest importance to meeting the challenges of climate change - heavy industry, natural solutions, cities, energy and climate finance" [10]. In May 2021, the UN Secretary General called to action in against climate change, and stressed that there is no time to waste in the fight against climate change [11].

Thus, the above factors provide sufficient grounds for the relevance and the need for special consideration by the program or national project on the preparation of cities and villages for climate change.

Justification

All factors of change on the territory of cities are considered in a synergistic combination - in the "living organism" of the city, in life support systems and their environment, the scenario of which will be strikingly different from the 11 negative factors of climate change and actions to mitigate them taken separately above. Multi-factoral influences and interactions on climate change require scientific research, modeling, development scenarios, forecasting at experimental sites or on the territory of a particular city in order to avoid the long-term negative consequences of urbanization.

Taking into account climate changes, climate control systems are being introduced into some modern cities. New models of cities are being built and the format of cities is changing, one of examples of such cities is Masdar City in Dubai [12]. Masdar City can be attributed to a small copy of the cities of the future.

In the absence of an array of scientific papers on the topic of the article, we can, in an empirical vision as an assessment, observation, or experience, assume that in high-mountain natural and climatic conditions, climate change in cities and towns will have a noticeable effect on life. For example, in Kyrgyzstan, water resources are glaciers, so all valleys and gorges have rivers and streams from high-mountainous, often breakthrough lakes, and all cities and towns are located inside these valleys. According to negative development scenarios, the presumptive graphic modeling of situations will show mudflow, seismic activity, and then a partial flood of cities during the melting of glaciers. Since the valleys and gorges where cities are located will partially flood, the question of the need for the construction at higher elevations where seismic or unpredictable geophysics are active will arise. In addition to that, the geodynamics of landscapes has not been studied enough. Subsequent forecasts predict drought and desertification of territories, that is why now constructions should be designed for arid climate, with other regulatory and technical requirements for construction and general plans of populated areas. But in Kyrgyzstan experts are unaware how to build in high mountains and in conditions of desertification, which means that the priority of problems in scientific research should be focused on construction in previously unexplored conditions, as well as reconstruction of cities, with possible scenarios of floods and droughts. Kyrgyzstan is a source of the world's fresh water reserves. It is a source of water for countries located in the lower reaches. Therefore, the problems predicted for Kyrgyzstan will affect and have consequences of regional significance.

The main results of the study are as follows:

1. Natural and climate changes, the change of flora and fauna should be comprehensively studied in several development scenarios in the main areas of the organization of life, such as cities and settlements. For this purpose, it is advisable to introduce national programs or projects to prepare cities and villages for climate change. There is a need to adapt urban policies towards creating safe living spaces and resource efficiency of life systems, and prepare adaptive systems for human beings.

2. The world has become unpredictable due to unexpected shocks like covid-19, socio-economic, environmental and climatic changes. In the Kyrgyz Republic, every third person lives below the poverty line and about 60% of the population and at the potentital risk of joining the first group. Under certain sufficient external, internal, including climatic circimstances, the possibility is increasing. In a developing country that is weak in terms of socio-economic indicators the priority issues that should be addressed are forecasting, anticipation of negative scenarios and planning to overcome them. The world's leading experts has come to the conclusion that it is impossible to predict the future, but the future can be designed and agreed to be implemented.

In this sense, it is best to start designing the future in advance, taking into account the maximum development risks.

The foundation for eco-cities should be laid today

The term of capital construction is 50 years: what is being built today should stand for 50 years. But even today, negative development scenarios predict floods and then the onset of low water, until the disappearance of glaciers by 2100. This means that we need to build a large number of dams and reservoirs, while city models should have a new format. The mountainous Republic has limited opportunities for transport mobility due to its landscape, so one of the main systems of organizing cities and localities shall preferably be oriented towards self-sufficient, autonomous (like the cantons in Switzerland), environmental development and appropriate infrastructure with the digitalization of the environment.

Taking into account the fundamental changes in the natural and climatic conditions in the long-term periods, the question of the security of territories shall be raised, requiring models, strategies and forecast scenarios for the development of the Future.

Conclusion

It is necessary to initiate and submit proposals to international research centers, foundations, and institutes on cooperation in the field of scientific research on preparing cities and villages to adapt to climate change.

We understand that we need both global and regional efforts of institutions for scientific and expert cooperation in order to preserve the resources and adapt cities and localities not only in the Kyrgyz Republic. Currently, the National Institute for Strategic Studies of the Kyrgyz Republic is working on a new scientific direction: Strategy for the Kyrgyz Cities Development in the Context of Climate Change.

Source of Research Funding

Source of research funding is the project: UN Partnership for Action on a Green Economy Initiative (UN PAGE), a contract of the National Consultant on Green Cities of the UNDP in the Kyrgyz Republic. The research was carried out within the green city topic; the topic of the article was not directly funded.

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