Green Infrastructure as a Factor in Ensuring Sustainable Development

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Abstract. Modern rates of urbanization have a negative impact on the natural objects of cities. In turn, residents expect high living standards. To cope with this contradiction allows the competent management of green infrastructure, which underlies the resilience of the city. It is important to note that not only the state is a participant in the development of the green infrastructure of the city. The researchers found that the active position of citizens also makes a significant contribution to its development. Therefore, reaching out to citizens, as well as increasing their interest in city issues, is an integral part of green infrastructure management. Under the influence of modern technologies, communication has changed in recent years. According to statistics, Russians spend an average of three hours a day on the Internet. In this regard, the management approach cannot remain unchanged: it is necessary to actively introduce new communication channels. Thus, in the field of management, the term e-governance (e-governance) has become popular, which implies the use of information and communication technologies in the management processes of the state. E-governance is directly related to the use of electronic devices that improve internal and external government relations, promote the economy and the efficient provision of services.

1 Introduction

A sustainable infrastructure system is characterized by the highest possible efficiency in the use of resources in accordance with an inclusive and integrated systems approach. This means proper collaboration between key stakeholders, with each project contributing to the sustainability of the infrastructure system and to a more resilient community as a whole [1]. Urban Infrastructures as a Development Driver Every city exists and develops, creating opportunities for its residents with the help of public infrastructures: social, engineering, transport, etc. Green infrastructure is a strategically planned network of natural and semi-natural areas, together with all the features of the environment (natural processes), designed and managed to provide a wide range of ecosystem services, such as water purification, air quality, recreational space and mitigation and adaptation to climate change. This is a network of green and blue (water) spaces that can improve environmental conditions and

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therefore the health and quality of life of citizens [2]. It also supports a green economy, creates jobs, and enhances biodiversity. Sustainable infrastructure plays an important role in the transition to a green economy as it is central to the Sustainable Development Goals (SDGs), covering all 17 goals and impacting 92% of the 169 targets.The Fourth Session of the United Nations Environment Assembly(UNEA 4), held in March 2019, focused on innovative solutions to environmental challenges, sustainable consumption and production. In this context, UNEA Resolution 4/5 on sustainable infrastructure pays special attention to sustainable infrastructure, recognizing its importance and calling for various actions aimed at sustainable consumption and production patterns, sustainable investment, capacity building, development and maintenance of infrastructure within a sustainable framework, etc [3]. P. While infrastructure programs are designed to meet social needs and provide basic services, they sometimes fall short of that goal. On the contrary, if infrastructure programs and projects are not properly planned and implemented with social considerations in mind, negative social pressures (eg population change, unemployment, gender inequality, etc.) may arise. For example, the pandemic has shown how socio-demographic problems can affect infrastructure systems in various regions of Europe [4]. Population aging, depopulation in remote, rural and/or border regions, and migration of the economically active population to cities are some of the main challenges. Therefore, it is essential to take into account these changes from the very beginning, as well as the opinion of beneficiaries and key stakeholders, when conducting a social impact assessment. If more inclusive and resilient infrastructure is designed, this can lead to significant monetary benefits for citizens, especially those with lower incomes. In addition, in addition to direct monetary benefits from economic infrastructure, social public infrastructure can also help develop human capital, especially youth and the workforce, while introducing innovations to better serve an increasingly large aging population.

2 Research Methodology

A characteristic feature of the development of modern society is the rapid growth of cities and the continuous rate of increase in the number of their inhabitants. Urbanization entails significant social changes in human history. An urban ecosystem is a spatially limited natural-technical controlled system (PTS), a complex complex of interconnected metabolism and energy of living organisms, abiotic elements, natural and man-made, creating an urban environment for human life that meets its biological, psychological, ethical, labor, economic and social needs [5]. A natural-technical system (NTS) is a set of natural, natural-technogenic and man-made objects, the conditions for the existence of which are interconnected and interdependent. The state of this system is determined by a complex of natural and technogenic factors. There are two main mechanisms for the formation of PTS. First of all, they are formed as a result of human changes in the natural environment, in the course of performing various types of technical activities [6]. These processes and phenomena are designated by the term “technogenesis”. The forms of technogenesis are diverse, as are the types of human activity that determine it. Regardless of the degree of technogenic transformation, some of the components of the natural environment continue to exist in the new conditions. At the same time, by changing the environment, a person keeps it suitable for his own existence [6]. Components of the natural environment not destroyed by technogenesis, incl. living organisms interact with new technical elements introduced into it. Formations of mixed origin (natural-technogenic objects) are being formed. Ultimately, a new system appears on the site of a previously existing natural ecosystem - a natural-technical one. There is also another mechanism for the formation of PTS. The adaptive potential of living organisms is great, it allows them to penetrate and develop in various types of equipment and structures that are created by man.

Some of them, massively settling in technical units and structures, prevent their operation and cause significant material damage. These phenomena are called “biological hindrances” or ”bio-hindrances” [7]. The development of global technogenic processes has led to the transformation of the Earth's biosphere into the biotechnosphere. In other words, the entire biosphere as a whole is turning into a PTS on a planetary scale, the state of which already largely depends on the consequences of human production activities, for example, on the “greenhouse effect” [8]. Consequently, the scope and structure of the TCP are very diverse. There are the following hierarchical levels of PTS: object (elementary), local, landscape, regional (national) and global. Among the infinite variety of PTS, three main types can be distinguished: spontaneous, regulated and controlled. An example of a spontaneous PTS can be a wetland mass formed at the exit of a city storm sewer. Most often, the development of such PTS goes through environmental degradation. The state of regulated PTS is controlled using special engineering and technical systems. These include well-maintained urban water bodies replenished from the city water supply system, together with a complex of hydraulic structures operating on them [9]. A controlled PTS is a system whose state can be manipulated, creating conditions favorable for human life in it. Such PTS include systems that are formed on the basis of large hydroelectric power plants, which, as a result of environmental optimization, turn into regulators of environmental conditions on a regional scale. They are able to maintain ecologically optimal parameters of river flow and groundwater levels, protect adjacent areas from natural and man-made emergencies (floods, droughts, accidental spills of toxic pollutants). Since the beginning of the 21st century, a number of empirical studies have been carried out to study existing initiatives in green logistics in individual countries and regions. A survey conducted by Eyefortansport compared green logistics practices among commercial logistics companies in the US, Europe, the Middle East and Asia Pacific using data from 536 respondents [9]. The results of the study made it possible to determine that green initiatives in logistics are quite common, and the most common tools are: route planning to reduce mileage, improve energy efficiency, create “green” warehouses and distribution centers. S. Zailani conducted a questionnaire survey to explore the perception of logistics managers in Malaysia of the impact of their activities on the environment [10]. The result of this study was the conclusion that more than half of Malaysian firms have never monitored the impact on the environment, and also did not have a formalized environmental policy or strategy. However, when surveyed, the majority of respondents showed a willingness to invest in green technologies. A study by S. Kim and S. Khan [12] attempted to classify green instruments in the transport sector. The authors collected data on 129 logistics companies in South Korea and, based on the results, green initiatives in logistics (environmental logistics practices) were assigned to three groups, according to which the activities of companies were further evaluated: environmental management (internal environmental management), environmentally-oriented supply and packaging (environmental sourcing and packaging), environmental design (environmental process design). R. Peters et al. studied green initiatives among the distribution and transport component of logistics activities in the Netherlands [13]. In this paper, the authors propose a generalization of the initiatives of logistics companies in the field of sustainable development in the form of a matrix based on the use of internal and external initiatives, optimization and innovation in the company. S. Zhang classified green initiatives in logistics into six groups based on survey data in China [14]: environmental management, low-emission storage and packaging, low-emission transportation, vehicle fleet management, alternative energy and innovative logistics. Separately, it should be noted the study of J. Baz and I. Lagier [15]. The study is based on interviews and was carried out in Morocco. The authors proposed a classification of four groups: the operation of vehicles (for example: the use of alternative fuels); warehousing and stock management (including reduction of household waste and used water, use of sustainable and recyclable packaging); environmentally oriented training and control (for example, the use of international standards, primarily the ISO 14001 environmental

management standard); interaction within the value chain on green initiatives. As in the case of the study by R. Peters, it was found that the applied initiatives mainly belonged to the first two classification groups [13].

3 Results and Discussions

The city is a natural-anthropogenic system, the elements of which are a person with his economic activity and the natural environment: relief, geological structure, climate, soils, plants, animals, surface and ground waters [11]. The interaction of these elements creates a specific ecosystem - a city and a kind of natural-anthropogenic urban environment. There is currently no consensus on what urban conservation measures and implementation methods cities should use, including benchmarking and prioritization tools that are critical for a city to identify problems and take action accordingly. For example, to date, existing green city indicators vary significantly from one initiative to another, reflecting the lack of a unified approach in existing urban conservation activities. This report recommends the development of green city indicators and a benchmarking and prioritization process for a green city framework, taking into account the NDS [12]. The proposed green city benchmarking methodology is inspired by the Developing and Sustainable Cities Initiative (ESCI) developed by the Inter-American Development Bank (IADB) and involves the application of traffic light screening against green city indicators with benchmarking against traffic light thresholds (“green”, “yellow”, “red”). While some indicative figures are offered, it is recommended that the EBRD establish country-specific benchmarks in order to comply with national standards and laws, taking into account the context of its countries of operations [13]. Traffic light screening is used to prioritize green city objectives and prioritize green city actions/policy options. To prioritize green city challenges and green city actions/policy options, a three-stage assessment is carried out [16]:

• A technical assessment by city officials and other professionals. In prioritizing green city objectives, this assessment will include traffic light screening against NDS indicators, which also evaluate individual, predictable indicator trends. Another technical assessment will be carried out during the preparation of the Green City Action Plan and will consist of the selection of policy options and the application of priority filters (environmental, economic and social impacts, budgets and estimates).

• Stakeholder prioritization: local experts and relevant stakeholders will complement the technical assessment by verifying and/or editing green city issues and identified actions.

• Political evaluation: this is a formal evaluation of the results of the previous steps in order to ensure that challenges are ultimately prioritized for problem solving and action. Unfortunately, the formation of a public demand for environmental modernization faces a number of problems caused, among other things, by the imperfection of the state climate and environmental policy. Often civil society organizations and activists working in the field of climate and environmental protection and forming a request for technological modernization are subject to persecution. Since 2012, the law on foreign agents has led to the liquidation of 22 out of 32 environmental NGOs declared foreign agents [14]. At the same time, there has been an increase in conflicts caused by environmental issues, up to street protests and direct clashes between local residents and builders and private security companies. At the same time, it must be understood that even such public campaigns as the preservation of green spaces in cities and the fight against natural fires are part of a policy to adapt to global climate change. Often in such situations, the state turns out to be a party to the conflict, and the authorities do not so much meet the concerns of citizens as repress the authors of environmental campaigns and data on environmental disasters, accuse activists of working for international forces of influence, contributing to the marginalization of the protest and showing that the state apparatus and law enforcement agencies are not independent arbitrators, but rather support polluters [17]. Over the past few years, the topic

of climate change has become important for Russian media, including social networks, but a number of Russian media, primarily federal TV channels, often cover the topic of climate change one-sidedly, mainly representing the position of climate skeptics. The Russian state, having recognized the problem of climate change and the anthropogenic factor as its main cause, can and should more actively form the climate agenda in the media through communication from relevant ministries and departments, state scientific institutions, supporting the work of scientific communicators and representatives of public organizations in this area. At the same time, it should be noted that the population of Russia is increasingly interested in the problem of climate change, considering it one of the most pressing environmental problems, noticing climate change and regarding it as a real threat [15]. In the education system, the topic of climate change has not yet received due attention. The introduction of climate change related topics into various educational programs and standards (including programs of secondary and higher schools, secondary vocational education, postgraduate education) will largely ensure the success of technological transformation based on climate and environmentally friendly technologies. In the field of science, it is necessary to stimulate academic exchange programs, educational programs abroad for personnel training and communication management in the context of the implementation of measures to prevent the worst climate scenarios and the introduction of a new climate policy in general. In particular, it is recommended to support the following areas [11]:

-expanding the subjects and problems of research; - collection, aggregation and verification of data, monitoring of greenhouse gases, glaciation and precipitation in the public domain; maximizing access to information and the publication of open data on climate issues;

- ensuring communication - within the scientific community, between researchers and practitioners, with society as a whole - for the most effective interaction of different actors, which will also make the situation understandable for the population, exclude the possibility of spreading false information and misleading citizens;

-creation of a transparent communication environment, access to which will be available to all interested parties, aggregation of scientific knowledge in the public domain, including the collection of all research done at the expense of the state and foundations, as well as support for the creation and launch of new scientific media, including those based on combining the principles of functioning of traditional academic journals and social media. For the development of further climate research in Russia, it may be useful to implement the idea of developing and implementing a state program for high-tech equipping of national climate research centers (for example, within the framework of the planned Federal scientific and technical program “Climate and Ecology”), embedded in the climate doctrine [16]. A shift in the social paradigm is needed from reacting to current events to proactively adapting to the changes expected in the coming decades. If the planning time horizon is extended, the demand for climate research will be extremely high [17].

4 Conclusions

The role of cities as central objects of sustainable development was identified in Agenda 211, a detailed analysis of research is presented in the works, however, UN SDG No. flexible and resilient”. Since countries ratified the Kyoto Protocol and subsequently the Paris Climate Agreement, climate change has come to be seen as a major issue for urban development and functioning at the international level5. In the near future, climate change will become a central issue for urban development6 and by 2030, millions of people and financial assets will be at risk of climate disasters, cities will be responsible for 75% of global CO2 emissions and at the same time experience serious consequences of these impacts. For example, the results of modeling of 140 cities around the world show a correlation between energy balance and sustainable urban mobility (public transport,

walking) and CO2 emissions. potential adverse human health impacts associated with climate change". At the same time, according to many researchers, the best option is achieved with a combination of adaptation and mitigation.

There is no mention of cities as integral units of adaptation to climate change in the National Action Plan until 20229. At the same time, elements of urban infrastructure that are subject to climate impacts are mentioned: transport, fuel and energy complex, construction and housing and communal services, as well as public health. Climate change issues are reflected in a number of existing building regulations, while others require operational adjustments.

The problem of climate change in Russian cities manifests itself in the following characteristics, depending on their geographical location, size, and population:

-for cities in coastal zones -flooding of coastal areas;

- for the cities of the Arctic zone - the thawing of permafrost and the destruction of the infrastructure of roads and buildings;

- for megacities - the transformation of cities as a whole into heat islands, the emergence of local heat islands inside the megalopolis in high-rise areas; the appearance of heat waves or cold waves;

-for megacities and industrial cities - an increase in the level of anthropogenic pollutants from industry and transport, as well as biogenic emissions (plant pollen, mold spores) under the influence of weather and climate changes; the appearance of clouds over cities with a high concentration of pollutants;

- for large cities - the impact on the health of the population of the listed factors of climate change;

- for all cities - an increase or decrease in the amount of precipitation depending on the geographical location;

-changes in biodiversity, emergence of invasive species;

-decrease in the absorption capacity of green spaces, the positive impact of green infrastructure on the processes of adaptation to climate change due to the reduction in the area of green spaces in cities due to cutting down for development of territories, death from diseases and concentrations of pollutants.

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