ADAPTATION OF THE HOUSING AND UTILITIES SECTOR OF BELARUS TO CLIMATE CHANGE

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Abstract

The article is devoted to assessment of impact of climate change on activity of housing and communal services sector in the Republic of Belarus. Assessment of climate change impact, risks and opportunities of housing and communal services sector was carried out on the basis of qualitative and quantitative analysis of sectoral «impact chains». Climate change impact assessments were carried out for water supply and sanitation (sewerage), rainwater sanitation. Heat waves, intense heat, droughts will have a significant negative impact. Warming in winter will have a positive impact on wastewater treatment. Based on the findings, a strategy for adapting the housing and utilities sector to climate change is currently being developed.

Keywords: housing and utilities sector of Belarus, climate change, adaptation measures

I. Introduction

In accordance with the National Strategy for Sustainable Socio-economic Development of the Republic of Belarus until 2030 [1], the main measures to reduce the impact of climate change on socio-economic development are:

- increase the ecological security of the territories by optimizing the location of production facilities and the organization of territories of settlements;
- modernization in the main industries;
- establishment of a natural risk management system;
- introduction of water-saving technologies;
- creation of reliable hydrometeorological monitoring and others.

The development of the «green» economy in Belarus implies solving environmental problems while ensuring economic security, social stability and creating additional conditions for the resumption of sustainable economic growth.

In many sectors of the economy there are real needs for the modernization of technological processes, the introduction of innovative «green» technologies that allow to increase the ecological sustainability of the economy and increase employment of the population by improving working conditions, and ample opportunity to do so.

Taking into account socio-economic conditions, prospects, expediency, international obligations, priority directions of development of «green» economy in the Republic of Belarus [2] include the following:

- implementation of sustainable consumption and production;
- development of the closed cycle economy (circular economy);
- formation of smart and energy efficient cities;
- development of electric transport (infrastructure) and urban mobility;
- climate change mitigation and adaptation.

These areas of development of the country's economy in the context of climate change are

directly related to the living conditions of the population, which supporting by housing and communal services.

Therefore, assessing the impact of climate change, vulnerability and climate risks in the housing and communal services sector in order to strengthen the planning system for adaptation to climate change in the Republic of Belarus is an important task at the present stage. The research was carried out within the framework of the project «EU for climate» in 2021-2022 with the financial support of the European Union (EU) and is implemented by the UN Development Programme (UNDP).

II. Methods

For the purposes of this study, the following activities of the housing and communal services are considered: drinking water supply and sanitation (sewerage), rainwater sewerage. The objects of the study are elements of engineering infrastructure and provided services of water supply and sanitation. The assessment also took into account the conditions of water supply and sanitation for urban and rural settlements, including water supply and the collection and treatment of domestic and surface wastewater from industrial plants.

Assessment of climate change impact, risks and opportunities of housing and communal services industry was carried out on the basis of qualitative and quantitative analysis of sectoral «impact chains». To identify the focus of priority adaptation measures to climate risks, information is needed on the difference in the magnitude of such risks in the spatial (e.g., regional/district) or temporal (current - future) dimensions. The standardized risk assessment methodology of the German Society for International Cooperation (GIZ) [3] was used for this purpose.

According to the GIZ methodology, the risk is divided into three main components: «exposure», «vulnerability» and «hazard», each of which is assigned its own weight and a set of indicators with their thresholds and its own weights. A numerical value is then calculated for each risk component, taking into account rationing of indicators. On the basis of the values of the risk components, the integral risk indicator for the examined system is calculated.

For example, the forecasting of future risks of disturbance of treatment facilities and risk of contamination of surface water bodies was carried out taking into account information about climate change and parameters of the system. The «exposure chain» for the risk of disruption of the operation of treatment plants with a set of indicators for each component of the given risk is presented in Fig. 1.

The «Hazard» component includes an increase in hot and very hot days, average annual rainfall and the duration of winter.

For the component «Exposure», two indicators have been selected: the number of cases of excess pollution of water bodies by wastewater and the coverage of the population by water treatment and wastewater treatment systems.

For the risk component «Vulnerability» four indicators were selected: two describe sensitivity («deterioration of water treatment infrastructure and facilities», «number of water bodies with poor and very poor ecological status»), and two describe adaptive capacity («developed national documents and technical standards» and «percentage of biological treatment plants»).

Analysis of sectoral «impact chains» allowed to determine the main risks, necessary measures and resources for adaptation of housing and communal services industry.

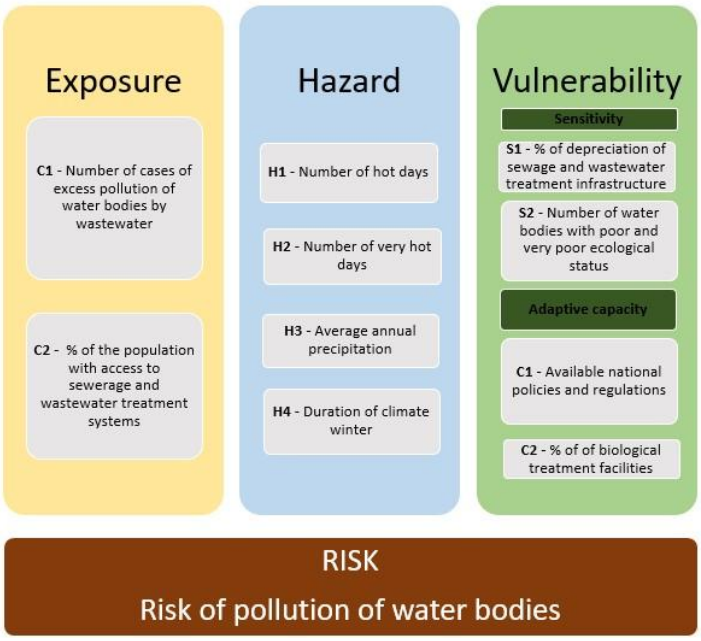

Figure 1: *«Exposure chain» for risk of disruption of treatment plants*

III. Results

The low impact of climate change on water supply is due to the use of groundwater for drinking water supply - the central water supply uses deep aquifers that are less susceptible to weather conditions. However, additional water will be required during hot periods, increasing pressure on infrastructure. The impact of climate change is most significant for areas not covered by central water supply, due to the reduction of water availability in the first aquifers from the surface during hot periods, especially during long heat waves. For regions where water is supplied from surface water bodies, the probability of not only decreasing water supplies but also polluting water sources increases during hot periods. Additional resources will be required to compensate for water shortages (water supply) and water treatment. In the case of heavy rains, there is a possibility of flooding and flooding of the water treatment and water supply infrastructure, especially in flood plains. Additional problems may arise due to the use of infrastructure with an excessive service life under increased loads during hot and heavy rains.

The impact of climate change on sanitation (sewerage) is both positive and negative. On the one hand, it is possible to reduce the cost of pumping, maintaining the required wastewater temperature, treating wastewater by increasing the length of the warm period and reducing the number of cold days. On the other hand, additional efforts will be needed during hot days and «heat waves» to maintain biological wastewater treatment processes. In addition, increased wastewater treatment costs will be required during a period of reduced water consumption and dilution capacity in watercourses. Additional problems may arise due to the use of infrastructure with an excessive service time under increased loads during hot and heavy rains. Higher temperatures lead to increased fermentation of solids in mud, resulting in an unpleasant odor. Harzards can lead to additional costs to eliminate leaks from municipal liquid waste storage systems in regions without a central sewerage system, additional costs for the export of sewage by special vehicles.

Treatment of wastewater to bring it up to the required quality parameters becomes technologically more complex and expensive due to higher temperatures, increasing and changing pollutant concentrations in the effluent. Heavy rains can cause flooding and disruption of sewage treatment plants through sewage maintenance.

Table 1: *Expected impact of climate change on processes and systems in housing and communal services in Belarus*

Parameter	Trend	Industry Processes and Systems			
		water intake	water treatment	water and sewerage system	wastewater treatment and collection
		slow changes			
Temperature	↗1,2	●		●	●
Hot days / «Heat waves»	↗3	●	●	●	●
Summer length	↗4	●	●	●	●
Duration of winter	↘4	●		●	
Cold days	↘4	●	●	●	●
Sediments	↗2,4				
Droughts	↗	●	●	●	●
		hazards			
Heavy rains	↗	●	●	●	●
Intense heat	↗	●	●	●	●
Hard frost	↘			●	●
Strong wind	[↘4]				●

Expected impact of these climate trends: ● strong ● moderate
direction of the impact: ● negative ● mixed ● positive

[ ] No forecast due to significant variability, analysis based on current trends
1 Above world average, especially fast in the summer-autumn period
2 Especially winter time
3 Uneven between seasons and areas, particularly vulnerable south-east of Belarus
4 Uneven across regions

The distribution of rainfall is the determining factor for rainfall. The main condition for the operation of rainwater is the intensity (supply) of rain and fluctuation of water level in water bodies. The most problematic are heavy rains in summer, causing flooding and flooding, destruction of water supply infrastructure and wastewater treatment.

The risk to the housing and utilities subsystems is due to changes in precipitation patterns (frequency and intensity of rainfall) and temperature factors (high air temperatures, frequency, duration).

In general, slow climate change may have a positive impact in terms of reducing the costs of certain winter processes (pumping and treatment of wastewater)However, droughts and long periods of heat will require additional efforts and costs to provide consumers with additional water, water treatment, water transport, etc. Extreme events, such as heat waves and heavy rains, can be particularly damaging.

IV. Discussion

Adaptation measures to climate change (Table 3) can be divided into:

- “soft” (including institutional and behavioural (related to educational processes, behavioural change), regulatory (i.e., in terms of law-making, regulatory legal framework, including technical normative legal acts, etc.), planning (related to the collection and use of climate information, territorial development, sectoral development programmes),
- “grey” (infrastructure) (related to the operation and construction of infrastructure, technological

processes and services),
- "green" (related to the use of natural solutions and the development of water-green infrastructure).

Table 2: *Expected impact of climate change on housing and communal services in general*

Parameter	Time horizon			Housing impact
	today	2040	2100	
slow changes				
Temperature	↗1	↗1,2	↗1,2	
Hot days / «Heat waves»	↗3	↗3	↗3	
Summer length	↗4	↗4	↗4	
Duration of winter	↘4	↘4	↘4	
Cold days	↘4	↘4	↘4	
Sediments	↗2,4	↗2,4	↗2,4	
Droughts	↗	↗	↗	
hazards				
Heavy rains	↗	↗	↗	
Intense heat	↗	↗	↗	
Hard frost	↘	↘	↘	
Strong wind	↘4	[↘4]	[↘4]	

Expected impact of these climate trends: ● strong ● moderate
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Belarus has a system for monitoring surface and groundwater quality. However, additional measures are needed to strengthen the monitoring system for groundwater and surface water bodies. Monitoring may also include modelling aspects to predict the availability of groundwater and changes in groundwater and surface water quality.

Studies to quantify the impact of climate change on groundwater and surface water, as well as on components of the water supply and sanitation system, taking into account the current infrastructure situation and projected climate change indicators, are relevant.

Information and education activities will raise awareness of stakeholders on the impact of climate change on water supply and sanitation. In addition, timely clarification of adaptation to climate change at different levels will increase the motivation of both residents and decision makers to apply adequate measures for the industry in response to climate change. The concept of improvement and development of housing and communal services until 2025 includes measures to improve the quality of training, retraining and advanced training of specialists in housing and communal services. Cooperation with citizens and organizations should also be strengthened. Outreach activities may also include information on problem areas, pollution prevention, flood and flooding prevention, operational telephones and others.

Planning the development of the industry taking into account expected climatic changes will reduce risks to the normal functioning of water supply and sanitation networks and services. Long- and medium-term planning involving all stakeholders to ensure a balance between demand and supply of quality water.

Table 3: *Analysis of needs and possibilities of industry adaptation*

Climate change impacts on housing and communal services in Belarus under the «impact chains» and adaptation measures reviewed	Water quality monitoring	Climate risk modelling for sectoral aspects	Informing and engaging stakeholders	Planning the development of the industry in view of expected climatic changes	Improvement of legal and technical requirements	Surveys of the technical condition of networks and structures, maintenance	Technical re-equipment of infrastructure facilities, increasing their efficiency	Water demand management	Land use regulation
Activity category	**M**	**M**	**M**	**M**	**M**	**C**	**C**	**M/C**	**3/M**
Shallowing of wells and disappearance of springs	✓	✓	✓	✓	✓	✓			
Increased contamination of wells and springs (nitrates, iron, heavy metals)	✓	✓	✓	✓	✓	✓			✓
Increasing average water demand	✓	✓	✓	✓	✓			✓	
Rising peak demand for water	✓	✓	✓	✓	✓			✓	
Reduction of water availability	✓	✓	✓	✓	✓	✓		✓	✓
Risks of water-borne diseases	✓	✓	✓	✓	✓	✓			✓
Increased costs and electricity consumption for water treatment	✓	✓	✓	✓	✓	✓	✓	✓	
Interruption of service provision	✓	✓	✓	✓	✓	✓	✓	✓	✓
Deterioration of filtration and cleaning systems by increasing the amount of suspended particles in water	✓	✓	✓		✓	✓	✓		✓
Increase in pathogens, smell in networks	✓	✓	✓			✓	✓		
Flooding of the network	✓	✓	✓		✓	✓			✓
Risk of flooding and flooding of urban areas, intensive erosion, erosion and damage to infrastructure	✓	✓	✓	✓		✓	✓		✓
Additional costs of sewage treatment for diversion to water	✓	✓	✓	✓	✓	✓	✓	✓	✓

Resources and capacity to develop and implement adaptation measures	

◎ Adaptation measures are needed
● Sufficient resources and capacity to develop and implement measures
● Limited resources and capacity to develop and implement measures
● Resources and capacity to develop and implement measures are scarce
C - "grey" activities; З - "green" activities; M - "soft" activities

Improvement of regulatory legal framework, including technical regulations, in terms of design standards (especially for «long-lived» facilities), ensuring the capacity of new networks, The improvement of requirements for the design and construction of treatment plants, technologies and cleaning methods, taking into account modern technologies and changing climatic conditions, will increase the efficiency of the system.

Surveys of the technical condition of networks and structures, maintenance allows to maintain maintained networks and installations in proper technical condition. However, the funds for repairs and replacement of equipment are only for minimal activities. As temperatures rise, extreme weather events (showers, heat waves, flooding) the cost of maintaining networks increases. Network maintenance programmes may need to be adjusted, including increasing the frequency of maintenance, additional provisions for wastewater treatment, etc.

Technical re-equipment of infrastructure facilities and improvement of their efficiency includes construction of new infrastructure, modernization of structures to increase efficiency and level of treatment of raw water and wastewater, to reduce their impact on the environment and public health.

Water demand management and conservation measures aim to strengthen and support existing mechanisms and practices to reduce water use. These measures may include both information and education and infrastructural measures aimed at the reuse of water.

The land management system provides for the restoration of ecosystems, the establishment and maintenance of borehole sanitary zones, the restoration of green vegetation, etc.

The implementation of programmes and strategies for the development of housing and communal services and related industries, aimed at the development of the industry, will reduce vulnerability and dependence on climate change.

Based on the findings, a strategy for adapting the housing and utilities sector to climate change is currently being developed.

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