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# INNOVATION FOR SUSTAINABLE WATER SECTOR

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***Abstract***

*Challenges regarding the sustainable management of the water sector require the diffusion of innovative technologies and the implementation of innovative solutions. The aim of the article is to make a SWOT analysis based on the assessment of the possibilities of innovations to contribute to sustainability in the water sector and the analysis of the problems for their implementation. This allows being outlined recommendations for improving the process of innovation implementation in the sector. The methodological framework of the study includes: 1. Theoretical review of the implementation of innovations in the water sector 2. Methodology for the study of sustainable management of the water sector through the implementation of innovations 3. Study of the problems and the possibilities for achieving sustainability through the implementation of innovations based on a survey among experts 4. Conclusion on the implementation of innovations in the water sector and recommendations for process improvement. The results in the article are part of a study related to the sustainable management of the water sector in Bulgaria.*

***Key words*****:** *sustainability, water sector, innovation*

## INTRODUCTION

Challenges in terms of low quality and quantity of water, adverse effects on public health and biodiversity, disruption of ecosystem services, water scarcity and drought, floods, which cause major economic losses and sometimes deaths, require the use and diffusion of new, region-adapted, innovative solutions [2]. Innovations have been present at every stage of human development, and over time they have changed their shape and appearance, but have always been a driving force and a factor for development [5]. Innovation in the water sector can be not only new sustainable technologies but also new partnerships in the field of public administration, research, and industry, new business models, and new forms of water management that are not only innovative but can also stimulate and support technological innovation. In addition, innovation does not need to be entirely new technology or concept, but new combinations and innovative ideas for improvements in modern technologies and systems, all of which must play a role in sustainable water management [3].

The implementation of innovative solutions to address the challenges in the water sector and support the development of innovations and their market diffusion leads to the accumulation of significant economic opportunities [9]. Innovation in the water sector is associated not only with the creation of new products or services, but also with the improvement of existing ways of managing water resources at a lower or the same price but with higher quality.

The scientific literature describes many barriers in front of the innovation in the water sector. Constrains for the diffusion of innovation include the widespread unwillingness of stakeholders in the water sector to test and use new technologies [3]. This is partly due to high investments in existing, long-lasting technologies because the maintenance or upgrading of this equipment requires a large part of current budgets [8]. Other barriers include the high cost of new technologies. As a result, different member states have different specificities and any company that launches a new technology may find that the cost of its certification is too high for some countries [3].

In some countries, consumers are required to pay to connect to the network system, so there

is no incentive for consumers to test new technology. Uncertainty about the ownership and management of water companies' assets can also slow down the spread of innovation. Effective water pricing can stimulate the uptake of innovations if it reflects real financial, environmental, and resource costs [7]. Many pricing policies still suffer from difficulties in defining and limiting a consumer group.

The main factors for the development of innovation are costs, technology, and stakeholders. When the costs associated with the application of cleaner technology are high, the old technological regimes are maintained [1]. Therefore, the transition from polluting to clean technologies is highly dependent on the economic situation of the country. At the same time, the introduction of innovations requires new ecologically oriented knowledge and infrastructure.

Technological opportunities play an important role in the implementation of innovations in the water sector. Improving technological capabilities through research and development stimulates the development of innovation [6].

Innovations require a wide range of knowledge, as their implementation often requires institutional changes, adoption of specific management systems, application of complex regulations, and others [4]. In this regard, the different intensity of innovation and especially eco-innovation, and their effectiveness in different countries depend on the level of development of research and development, the availability of the necessary qualified staff, the development of cooperation, networks etc. [6].

## MATERIALS AND METHODS

The aim of the article is to make a SWOT analysis based on the assessment of the possibilities of innovations to contribute to sustainability in the water sector and the analysis of the problems for their implementation. This allows being outlined recommendations for improving the process of innovation implementation in the sector.

The results in the article are part of a study related to the sustainable management of the water sector in Bulgaria [10].

The methodological framework of the study includes:

1. Theoretical review of the implementation of innovations in the water sector
2. Methodology for the study of sustainable management of the water sector through the implementation of innovations
3. Study of the problems and the possibilities for achieving sustainability through the implementation of innovations based on a survey among experts
4. Conclusion on the implementation of innovations in the water sector and recommendations for the process improvement.

The analysis is based on a survey conducted with experts at the national level on the possibilities for achieving sustainable management in the water sector through the introduction of innovations. The participants in the study are experts from municipal administrations who are well acquainted and qualified in the field of policies and instruments for achieving sustainable water sector management, risk management in the water sector, and innovation. 20 experts with the necessary competence on the researched issues participated in the survey. The survey was conducted in the period November 2019 - January 2020.

The tool used in the article is the SWOT analysis. It is applied to analyze achieving a sustainable water sector in Bulgaria through innovation. To determine the main elements in the development of the SWOT diagram for the purposes of the article, research questions are set regarding the strengths and weaknesses, opportunities, and threats.

The research questions for the different elements of SWOT analysis are as follows:

**Strengths**

-How can we use our strengths to achieve sustainability in the water sector through innovation?

-Which are the advantages of implementing innovations in the water sector?

-How does the implementation of innovations in the water sector contribute to its sustainability?
-How will we use the specifics of implementing innovations in the water sector as a strength to achieve sustainability?

**Weaknesses**

-How can weaknesses in the implementation of innovations in the water sector be reduced or eliminated before they become a threat?
-What could be improved in the implementation of innovations in the sector and how?
-Which factors (internal and external) are considered as weaknesses in the implementation of innovations in the sector?

**Opportunities**

-What could be the opportunities for innovation in the water sector and how can existing ones be better used to overcome weaknesses and / or threats?
-Which are the good opportunities (short-term, long-term)? Which of the good opportunities are easily feasible and which can only be realized by changing the external environment?
-Are there any potential opportunities to contribute to sustainable management in the water sector? How can they be reached?
-Are there any potential opportunities to contribute to the dynamization of the process of innovation in the water sector? How can they be reached?

**Threats**

-What are the main constraints aimed at introducing innovations in the water sector in the short term?
-What are the main constraints aimed at implementing innovations in the water sector in the long term?
-Will the change of the external environment constrain the introduction of innovations in the water sector?
-What are the possible threats arising from the external environment in the implementation of innovations in the water sector?
-Which threats arise from the lack of innovation in the water sector?

The questions used in the questionnaire for the purposes of this article are related to the assessment of the challenges and barriers to the implementation of innovations, as well as the factors for the implementation of innovations in the water sector (Table 1).

Table 1. Assessment of the challenges, barriers, and factors for the implementation of innovations in the water sector

| Challenges | Barriers | Factors |
|---|---|---|
| • Poor quality of water resources.<br>• Lack of water resources.<br>• Adverse effect on public health.<br>• Adverse effects on biodiversity.<br>• Obstruction of the provision of ecosystem services.<br>• Drought.<br>• Flood. | • Unwillingness of stakeholders in the water sector to use new technologies.<br>• Serious investments in existing, long-lasting technologies.<br>• High cost of new technologies.<br>• Uncertainty regarding the ownership and management of water companies' assets.<br>• Difficult access to funding sources.<br>• Lack of need for innovation. | • The value of the costs incurred for innovation.<br>• Technology requirements.<br>• The requirements set in the legislation.<br>• The desire of stakeholders. |

Source: Own conception.

## RESULTS AND DISCUSSIONS

The assessment of the achievement of a sustainable water sector through innovation was realized through questions included in the expert survey. Innovations are assessed as important for overcoming the challenges in the water sector. They have a high (50%) and very high significance (30%) for improving the quality of water resources. They are also important for overcoming their shortage, as 20% define them as those of high significance and 70% as very high. The importance of innovation for overcoming the adverse effects on public health due to quantitative and qualitative problems of water resources is defined as high by more than half of the respondents (Table 2). 25% consider this

significance as low, and 10% believe that it is missing. The opinion on the importance of innovation in overcoming the adverse effects on biodiversity differ, and in general, it can be defined as average. Such assessments were given by more than one third of the respondents, 30% consider that the importance is high, 25% that it is low, and 10% share a view that it is missing. More than half of the respondents define the importance of innovation for the provision of ecosystem services as high and very high, and 25% define it as average.

Table 2. Assessment of the importance of innovation to overcome the main challenges in the water sector, %

| Challenges | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Poor quality of water resources | 0 | 0 | 20 | 50 | 30 |
| Lack of water resources | 0 | 5 | 5 | 20 | 70 |
| Adverse effect on public health | 5 | 10 | 30 | 45 | 10 |
| Adverse effects on biodiversity | 10 | 25 | 35 | 15 | 15 |
| Obstruction of the provision of ecosystem services | 5 | 15 | 25 | 40 | 15 |
| Drought | 0 | 0 | 30 | 40 | 30 |
| Floods | 5 | 5 | 25 | 45 | 20 |

1 - lack of significance; 2 - low significance; 3 - average significance; 4 - high significance; 5 - very high significance
Source: own research [10] .

Only 15% consider it is low and 5% think it is missing. Innovation is important for overcoming drought problems. 30% describe this importance as a medium, 40 % as high, and the remaining 30% as very high. Innovation activity is also important for overcoming floods and 90% of the experts indicate high scores in general.

The barriers to the implementation of innovations in the water sector proposed in the questionnaire are assessed as serious (Table 3). The high cost of new technologies is defined as a serious (40%) and very serious (30%) problem, and difficult access to sources of funding as a serious constrain for 30% of the experts and very serious for 40% of them. Uncertainty regarding the ownership and management of the assets of water companies is also a barrier, which is assessed as an average - 25%, serious - 30% and, very serious - 30% of the respondents. Lack of need for innovation and unwillingness of water supply to use new technologies are not defined as very serious barriers in front of the innovation. They are defined as barriers with average scores. Serious investments in existing long-term technologies receive mixed assessments if they are constrained or not. Experts define them as: very serious - 15%; serious - 25%; medium - 30%; small barrier - 20% and they are no barrier for 10%.

Table 3. Assessment of the main barriers in front of the implementation of innovations in the water sector, %

| Barriers | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| The unwillingness of stakeholders in the water sector to use new technologies | 10 | 30 | 40 | 5 | 5 |
| Serious investments in existing, long-lasting technologies | 10 | 20 | 30 | 25 | 15 |
| High cost of new technologies. | 5 | 10 | 15 | 40 | 30 |
| Uncertainty regarding the ownership and management of water companies' assets | 0 | 15 | 25 | 30 | 30 |
| Difficult access to funding sources | 0 | 0 | 30 | 30 | 40 |
| Lack of need for innovation | 10 | 20 | 45 | 25 | 0 |

1 - It is not a barrier; 2 - Small barrier; 3 - Medium barrier; 4 - Serious barrier; 5 - A very serious barrier
Source: own research [10] .

Many of the factors included in the survey for the development of innovation in the water sector receive a high score (Table 4). Technology requirements (75%) and stakeholder willingness (70) are identified as definitely important factors for more than half of the respondents. The value of the costs incurred for innovation and the requirements set in the legislation are definitely important factors for the development of innovation in the water sector for 45% of the surveyed experts. The value of the costs incurred for innovation is rather an important factor for the development of innovation in the sector for 55% experts. The requirements set in the legislation are an important factor for 40% of the respondents and the willingness of the

stakeholders for 25% of them are identified as rather important factors. No factor is defined as one that is not important at all or rather unimportant. Only 5% of the experts identify technology requirements and legal requirements as rather unimportant factors.

Table 4. Assessment of the main factors for the development of innovations in the water sector, %

| Factors | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| The value of the costs incurred for innovation | 0 | 0 | 0 | 55 | 45 |
| Technology requirements | 0 | 5 | 5 | 15 | 75 |
| The requirements set in the legislation | 5 | 5 | 5 | 40 | 45 |
| The desire of stakeholders | 0 | 0 | 5 | 25 | 70 |

- Not important at all; 2 - Rather not important; 3 - No opinion; 4 - Rather important; 5 - Definitely important;
Source: own research [10].

## SWOT analysis of the implementation of innovations in the water sector

Strengths due to the implementation of innovations in the water sector are overcoming the shortage of water resources and improving the quality of water resources (Table 5 and Table 6).

Table 5. SWOT analysis of the implementation of innovations in the water sector in Bulgaria, ( Strengths and Opportunities)

| STRENGTHS |
|---|
| • Overcoming the shortage of water resources.<br>• Improving the quality of water resources.<br>• Availability of highly qualified staff for implementation of innovations in the sector.<br>• High added value.<br>• Financial assistance under the operational programs.<br>• Overcoming the adverse effects on public health due to quantitative and qualitative problems of water resources. |
| **OPPORTUNITIES** |
| • Provision of ecosystem services.<br>• Overcoming drought problems.<br>• The requirements regarding the technologies set in the legislation.<br>• Climate change.<br>• The risk of floods.<br>• The level of development of research and development.<br>• Level of development of cooperation networks.<br>• Efficient water pricing. |

Source: own research.

The availability of highly qualified staff for the implementation of innovations in the sector and financial assistance under the operational programs are also defined as strengths.

The strengths of the implementation of innovations in the sector is the overcoming of the adverse effects on public health due to quantitative and qualitative problems of water resources.

The implementation of innovations in the water sector leads to the creation of high added value, as it benefits from the investment of innovative components from other sectors (IT, construction, infrastructure).

A weakness in the sector is the serious investments in existing, long-term technologies for the operation and maintenance of water infrastructure, which affects the dynamics of the process of implementing innovations.

Table 6. SWOT analysis of the implementation of innovations in the water sector in Bulgaria, (Weaknesses and Threats)

| WEAKNESSES |
|---|
| • Uncertainty regarding the ownership and management of water companies' assets.<br>• Serious investments in existing, long-lasting technologies.<br>• Unwillingness of the stakeholders in water sector to use new technologies.<br>• Strong dependence on other sectors and the innovations developed in them.<br>• High cost of new technologies. |
| **THREATS** |
| • Difficult access to funding sources.<br>• Lack of need for innovation and unwillingness of water supply to use new technologies.<br>• Unwillingness of stakeholders.<br>• The value of the costs incurred for innovation.<br>• Lack of awareness.<br>• Change of the legislation in the water sector.<br>• Lack of technical assistance for implementation of innovations. |

Source: own research.

The unwillingness of the stakeholders in the water sector to test new technologies is defined as a weakness precisely because the serious investments in existing, long-term technologies and the maintenance of water infrastructure requires serious funding. Uncertainty regarding the ownership and asset management of water companies leads to the limited implementation of innovative solutions in the water sector.

The implementation of innovations in the water sector is highly dependent on the development of innovations in other sectors such as IT, construction, specialized equipment, and others. Challenges facing the water sector such as drought, climate change, flood risk can be identified as an opportunity to stimulate innovative solutions in the water sector, as the problems are expected to deepen. The implementation of innovative solutions to address the challenges in the water sector and support the development of innovations and their market diffusion will increase the value of ecosystem services. The efficient pricing of water and its connection with the innovations in the sector is an opportunity to dynamize the process. An opportunity for innovation is to stimulate the development of cooperation networks, as innovation processes are carried out through the interaction between multiple users and stakeholders (water users), research centers and governmental, and local authorities.

Threats to dynamize implementation of innovation in the water sector are associated with difficult access to sources of funding and the value of the costs incurred for innovation. At the same time, the lack of need for innovation and the unwillingness of stakeholders in the water sector to use new technologies is a threat. Lack of information and technical assistance for the implementation of innovations is also identified as one of the barriers in front of the implementation of innovations in the water sector.

## CONCLUSIONS

Based on the theoretical review and analysis of the opportunities, and barriers to the implementation of innovations to achieve a sustainable water sector, the following conclusions could be summarized:

-Water innovation can be both new sustainable technologies and new partnerships, business models, forms of water management, combinations and innovative ideas for improvements in modern technologies and systems, all of which must play a role in sustainable water management.

-The innovations are assessed as significant for overcoming the challenges in the water sector in terms of improving the quality of water resources, overcoming the shortage of water quantities, the adverse effects on public health due to quantitative and qualitative problems of water resources, for providing of ecosystems.

-Definitely important factors for the development of innovation in the water sector are determined by the requirements in terms of technology and the willingness of stakeholders. The value of the costs incurred for innovation and the requirements set in the legislation are definitely important factors for the development of innovation in the water sector.

-The barriers to the implementation of innovations in the water sector proposed in the survey are assessed as serious. High costs of new technologies are defined as serious constrain, difficult access to funding sources, uncertainty regarding ownership and asset management of water companies are identified as very serious barriers in front of the implementation of innovation.

The following recommendations can be given to dynamize the process of implementing innovations to achieve a sustainable water sector:

-One of the weaknesses defined in the SWOT analysis is the uncertainty of ownership and asset management of water companies. In this regard, the recommendations of the EIP Water Working Group on creating a network between buyers can be taken into account. In this way, groups can exchange information on best practices.

-Coordination and joint decision-making between stakeholders is also needed to develop and implement innovative technologies.

-Stakeholders need to understand that innovation is the main source of competitive advantage and in this regard, it is necessary to apply models for developing innovative strategies for innovation in the water sector, which are consistent with the needs of society, institutions, and the environment.

-Grants, financial incentives, and pricing strategies can help for buying innovation.

-The lack of need for innovation from stakeholders and the unwillingness of stakeholders in the water sector to use new technologies can be overcome by implementing one initiative recommended from the Union in the field of innovation, included in the Europe 2020 strategy, which is to create European partnerships for innovation. They will accelerate the spread of innovation in the water sector.

-The main weaknesses and threats are the value of the costs incurred for innovation and the high cost of new technologies, as well as the difficult access to funding sources. They could be overcome through new funding approaches. In the strategy paper for water innovation [9] is proposed the creation of a common structure at the European level to build an interface between funding institutions and industry, which stimulates innovation and improves knowledge of access to finance. It is also proposed to improve access to finance for small and medium-sized enterprises and to build frameworks and tools to stimulate public sector innovation in priority areas, based on a review of best practices in public procurement.

-Lack of awareness of stakeholders can be overcome by applying a dissemination approach. Many innovations are relatively new (renewable energy, electro mobility) and are more dependent on external sources of information and research compared to already established innovations. In this regard, universities and other research institutions play a significant role in the development and implementation of innovation in the water sector. These institutions can also contribute to the provision of highly qualified professionals with education in new scientific fields.

-Good legislation can stimulate environmental technologies and lead to challenges such as insufficient research capacity, inadequate functioning of the research system, weaknesses in information and training.

As conclusion, challenges regarding sustainable management in the water sector require increasing the diffusion of innovative technologies and the implementation of innovative solutions that take into account the specifics of the regions. This will give competitive advantages for both businesses and regions.

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