

## WATER RESOURCES MANAGEMENT IN THE FUNCTION OF SUSTAINABLE URBAN DEVELOPMENT

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### Abstract

Human beings impact the environment in all ways, including the natural water regime versus urban water management. Also, water is inseparable part of the city design, but the uncontrolled presence of water in urban areas may cause great damages. This problem caused to research the management of water resources and the level of implementation of Sustainable Development Goals that are adopted by United Nations General Assembly, as an integral part of the 2030 Agenda for Sustainable Development. Also, this paper illustrates the awareness of the competent authorities and the awareness of ordinary citizens for water in urban areas. A comparative analysis is made through specific problems related to water resources in the territory of Europe and the Republic of North Macedonia, taking as a specific example the city Gostivar. As conclusion, it is noted that sustainable management of water resources integrates several connected fields such as protection from climate changes, quality of life, energy efficiency, etc. It also includes the consciousness of a society, policy makers and individuals in managing with water resources. Due to the importance of water management for a sustainable urban development, it is recommended that spatial planning of the city and the management of water resources must be done parallel.

*Keywords:* water resources, sustainable development, urban area, city, floods.

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### 1. Introduction

Water in Earth is present in different forms: surface water oceans, seas, lakes, rivers, canals, and groundwater [1]. Flood happens when the elevation of surface water exceeds the elevation of the ground. It is known as a natural disaster. In rural areas with a low concentration of population, this natural disaster is often expected due to agricultural land, and even nature itself quickly adapts to the new conditions. But it is different when it comes to urban areas. Then the real hazard happens, where this natural disaster usually causes great material damages and taking away human lives. It is true for flood being natural appearance [2] but we are witness of many cases where this disaster happens as a result of not appropriate management of water resources. On the other hand, there are still many places where even drinking water is absent [3].

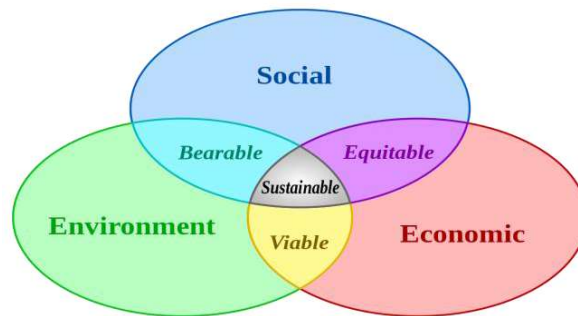
For many years' people have been trying to manage water resources in many different ways by the construction of infrastructures in the urban areas, using water for energy production, by irrigating the agricultural lands, etc. Now is an urgent time to walk towards new concept of water management that guarantees protection from floods and water scarcity, where not only experts but also ordinary people are involved, the concept of sustainable management of water resources [4]. Because at the Sustainable Development Goals (SDGs) adopted by the United Nations General Assembly, great importance is devoted to waters [5] which is in a close relationship with Sustainable Management of Water Resources. Sustainable Management of Water Resources includes the consciousness of a society, policymakers, and individuals in managing water resources. It unequivocally currently treats the ethics on water

use, environment protection and climate-changing. A punctual water management with an operational plan for sustainable management of water resources would be ethical and would settle the urban problems which arise from water scarcity and the risks from floods on the other side. This depends on human behavior with the water environment considering the changes as well in nature which arise with the anthropogenic factors as dominant in the disruption of the natural water regime in the natural environment [2].

To take the right steps towards sustainable development, the first thing to do is identifying where we are standing. Based on detailed analyses, problems and the sources of the problems should be detected. That is the main purpose of this paper - detecting the problems that keep the city of Gostivar, as a case study, away from sustainable management of water resources. By analyzing the actions taken and those planned to be taken, a current situation of the city of Gostivar was foreseen. In the following sections conclusions and recommendations are given, what should next be done to cover all the targets of the 6th goals of SDGs implementation in the city Gostivar.

**2. Water’s place in the Sustainable Development**

As is well known, 71% of the Earth consists of water [6]. Despite this fact, still, more than 2 billion people have no access to drinking water [3] or have no water for sanitation and hygiene. On the other hand, many countries experience flood appearance. All things considered, water resources are unevenly distributed in time and place. For many years, using different techniques man tried to manage water resources, in purpose to balance the presence of water in urban areas. Sustainable development opened a new way of thinking – “fulfilling the needs of the current generation without compromising the opportunities of future generations to meet their needs”, [7]. After over two years of trying to integrate economic and social development with environmental sustainability, in September 2015, as shown in Fig.1. The United Nations General Assembly adopted the Sustainable Development Goals as an integral part of the 2030 Agenda for Sustainable Development [8].



**Figure 1.** Sustainable Development  
 Source: Youcreatecommunity.com (2016). *Garden Community Project*

The Sustainable Development Goals (SDGs) are 17 totally in number as shown in Fig.2 [4]. Water is present in all spheres of life and all goals are closely linked to goal 6, *Ensure availability and sustainable management of water and sanitation for all*, which is related exactly to water management. Likewise, Professor Zafar Adeel, on his research for the water security within the 2030 agenda for sustainable development concluded that “achievement of all water-related Sustainable Development Goals (SDGs) and underlying targets is crucial to the success of the entire suite of SDGs about universal health, food security, gender equality, sustainable consumption, resilient urbanization, and conservation of marine resources and terrestrial ecosystems” [9].



**Figure 2.** Sustainable Development Goals  
 Source: www.worldcoo.com (2016). Sustainable Development Goals

**3. The level of implementation of sustainable water management in Europe and Republic of the North Macedonia**

The goal six of the SDGs represents sustainable management of water resources by its 6 targets, given in Fig. 3, focusing on achieving access to drinking water and sanitation for all citizens, improved quality of water resources, increased water-use efficiency, restored water ecosystems, application of integrated water resource management principles [5]. All these targets guarantee sustainable management of water resources if properly implemented.



**Figure 3.** Goal 6 and its targets  
 Source: Institution of Civil Engineers (ICE). *Achieving SDG 6 – the ‘Water Goal’ is the prerequisite for agenda 2030 for sustainable development, London*

The following sections will represent an overview (will give a summary) of the current position of sustainable management of water resources in urban areas in Europe, the Republic of North Macedonia with detailed analysis of the city of Gostivar, determining the gaps and possible solutions to fulfill them.

### **3.1. Europe**

In 2000 the European Commission (EU) established The European Water Framework Directive (WFD) as a single piece of framework legislation to resolve the water problems enduring sustainable water resource management. "The WFD provides a framework for water protection and management in the EU" [10]. The main key aims of the WFD are: protection to all waters, surface waters, and groundwater, achieving "good status" for all waters, management of river basins, getting the prices right, streamlining legislation, public participation, coordination of measures [10]. As stated from the European Environment Agency, four other directives have been added to these directives to "ensure the good status of Europe's waters": The Floods Directive, The Urban Waste Water Directive, the Bathing Water Directive, the Nitrates Directive, the Drinking Water Directive [10].

### **3.2. Republic of North Macedonia**

The main goal of North Macedonia's goal is to become part of the European Union. The European Water Framework Directive (WFD) is incorporated into the North Macedonian laws. North Macedonian legal frame dealing directly or indirectly with water management water resources covers several regulations, giving the main stress to the Law on Environment, Law on Waters and Law on Nature Protection [11].

Sustainable management of water resources in the Republic of North Macedonia is done by the main strategic documents for SDG 6 that govern and address all of the goal's targets, such as: National water strategy; Water economy base; River basin management plans [12], etc. The Law of waters of North Macedonia defines waters as a common good and sets water management and protection rights and obligations, to preserve the natural condition and even improve them. In addition, the responsibilities and obligations are divided into six ministries: Ministry of Environment and Physical Planning; Ministry of Transport and Communications; Ministry of Economy; Ministry of Agriculture, Forestry and Water-Economy; Ministry of Education and Science Ministry of Health and the Republic Institute for Health protection [11].

During the 32<sup>nd</sup> AGUASAN workshop, held in Spiez, Switzerland, draft SDG#6 strategies were prepared for three country cases, including the Republic of North Macedonia. The strategies gave a mirror about the current situation of the countries and include practical means of implementation of the sixth goal of SDGs. For the Republic of North Macedonia is concluded that: current level of water supply coverage: rural: 60-80%, urban: 95-100%; estimated current level of sanitation/wastewater collection coverage: rural: 20-60%, urban: 90%; current level of coverage by wastewater treatment: 15% of total population; current rate of cost recovery for water and sanitation services: average at country level > 60% (but there are public utilities with around 90%); current level of IWRM implementation estimated at 20%; the institutional and legal framework for ecosystem preservation is in place [13].

Achieving the targets of goal 6 of the SDGs are challenges for the Republic of North Macedonia [14] - many of them are conditions for the country to enter into the EU. As a result, there exist a great number of different strategies and legislations that dial with the targets for sustainable water management, but the implementation of them is going slowly. According to the European Commission Report for the Republic of North Macedonia in 2018 [15] is stated that on some fields of sustainable water resource management the country achieved some levels of preparation but more efforts are required to reduce non-revenue water, to make significant efforts in enforcement and inter-institutional coordination.

#### **3.2.1. The case study - The city of Gostivar**

The city of Gostivar is located in (gorni!) Polog in western of the Republic of North Macedonia. It is one of the biggest cities in the region of Polog. Gostivar is known as the city where Vardar, the biggest river in Republic of North Macedonia, starts its journey [16].

Actually the spring of river Vardar is in Vrutok village, a few kilometers southwest of Gostivar in the north-western part of the Republic of North Macedonia. Vardar divides the city of Gostivar into two parts, continues straight to the capital city Skopje, passes the country to finally reach the Aegean Sea.



**Figure 4.** The city of Gostivar, Republic of North Macedonia  
Source: [25]

The water resource management in this city is done mainly by two institutional units. One is the Water Economy, self-governing institution and the other is Public Utility Company “JPKD Komunalec” within the municipality of Gostivar. So, the main responsibility for the level of implementation of the 6<sup>th</sup> goal of SDG belongs to these two units. By analyzing each of them, a comparative analysis is done between them and the targets of the 6<sup>th</sup> goal of SDGs, [17] from where at the same time emerges the level of integration of the specific SDG targets in the current situation in the city of Gostivar.

### ***Targets of Goal 6 of the SDGs and their implementation in the city of Gostivar***

Target 6.1: “Achieve universal and equitable access to safe and affordable drinking water for all”

In the city of Gostivar drinking water mainly originates from the spring of the river Vardar, but it has been a problem for many years. The problem becomes bigger during the summer months, where there is a lack of drinking water in many parts of the city. Drinking water supply is under the responsibility of the Public Utility “Komunalec” of Gostivar, as mentioned before, within the framework of the Municipality of Gostivar.

In September 2012 an agreement is done, between the government of the Republic of North Macedonia and the government of the Swiss confederation on the granting of financial assistance for the project “Improvement of the Gostivar water supply system” [18]. The main goal of this project has been to contribute to the sustainable development of the Gostivar region, through the improvement of living conditions for the population and protection of the natural resources [19]. The project started in September 2013 and has been going on for several years. According to 7<sup>th</sup> Steering Committee of the project, in October 2016 [20] only a small part of works has been delayed till then and the project’s time extension has been up to June 2017. The work that hasn’t been covered with this project, it is planned to be done by 2019, according to the tender published in November 2018 [21]. The German Financial Cooperation with the Republic of North Macedonia, Ministry of Transport and Communication, MoTC, Municipality of GOSTIVAR started a new project named “Water and Sewerage Programme Macedonia”. This project includes water supply for many parts of the

city and its surroundings. Another technique of water management that has not been seen in this city before included in the project is the construction of 4 reservoirs in four different parts of the city. The reservoirs are intended to serve the citizens to supply water for at least 3 days at a time of lack of drinking water.

Target 6.2: *“Achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations”* Although a large percentage of work planned by the municipality has been realized, still a part of the city has no water supply system. The system is even less developed in the surroundings of the city. People face this problem by supplying with water from the nearest possible water source or open their own wells. No obvious gender injustice is observed. In cases where the source is in the vicinity, the supply of water can be made even by women, but when it comes to larger distances or opening of wells, these jobs are done by men. The technical water for sanitation and hygiene is supplied by the same system that provides drinking water. Sanitation in the city of Gostivar includes wastewater collection, sewage, and septic tanks.

Target 6.3: *“Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally”*

To track the quality of water in the city, a detailed analysis of quality of water is done every month. According to the latest expert analysis from the public health center in Tetovo, made in March 2019, it is estimated that the water in Gostivar is drinkable and responds for use according to the regulations on drinking water safety [22].

Public Utility Company “JPKD Komunalec”, Gostivar is responsible also for the regulation of fecal and atmospheric sewerage in the city. Wastewater is mostly discharged untreated into the river Vardar. Although with the lack of proper sewage and sewage disposal the city is threatened by a high risk of pollution of the living environment, a large part of the city does not have sewage. Currently, the septic tanks seem to be an interim choice which is also a lack in many parts of the city. In this case, mostly incurred is the river Vardar and the streams.

Target 6.4: *“Substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity”*

According to Komunalec of Gostivar, the water supply system provides 900 to 1200 l/s, which seems to be enough to meet the needs of the number of the citizens of this small city, such as Gostivar. But again water shortages are frequent appearances during the summer months. This is mainly because people use the drinking water to irrigate their gardens having no consideration for people suffering from water scarcity.

Target 6.5: *“Implement integrated water resources management at all levels, including through transboundary cooperation as appropriate”*

Integrated water resources management is not completely implemented in the city of Gostivar. First of all, the communication between the two units responsible for the management of the water in the city is weak. New urban plans are being adopted. As a result, new buildings are taking place in the city, which require additional water quantities and the supply network is old and with limited capacity. The wastewater remains untreated and thrown in the river Vardar. Rainwater is not used for anything in the city, and even the problem is that heavy rains may cause floods. The same thing happens with the groundwater. The corporation between neighbor cities, related to water resources is not enough. The



population is rarely consulted for determining their problem, need and their participation in taking decisions is limited. The city supply water is used for the irrigation of city parks and other public places and also for extinguishing the fire.

Target 6.6: “*Protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers, and lakes*”

As mentioned before, the greatest river in the Republic of North Macedonia begins in Gostivar. It is the responsibility of the Water Economy to supervise the Vardar River. The bed of the river Vardar is in form of double trapeze, with a capacity of 46 m<sup>3</sup> / s for a minor channel, 135 m<sup>3</sup>/s and for a major channel, corresponding to 1000 years water, as can be seen in Fig.5 [23]. In this way, the flood protection system for the city of Gostivar is established in the urban areas.



Figure 5. The river Vardar in the urban area of city of Gostivar  
Source: [26]

#### 4. Discussions and Recommendations

The drinking water shortages are awaited to be gone by 2019 because the authorities have given great effort for the construction of proper infrastructure. Also, the quantity of water provided for the city, if well managed, can cover the need of the citizens. The quality of the water reaches the criteria to be healthy and drinkable. All mentioned would help the achievement of the first target in urban areas of the city. To achieve water-use efficiency, the management and monitoring capacities should be strengthened also water-saving technologies should be implemented.

In spite of the fact that weighty steps have been taken on water waste treatment by the local authorities, still the job can't be counted as completed. This can become seriously dangerous for the health of the citizens.

The river bed is regulated in the urban area due to flood protection. Further investigations for its reconstruction are needed to be done.

Technically the old water supply network of the city should be replaced with a new one. Another thing that is easy and undoubtedly ethical is to research the possibilities for using rainwater before it reaches the ground to provide more clean water and protect an urban area from flooding. “Moreland can be used for building high-rise apartment blocks – on the

condition that flooding is reduced to a minimum by rainwater collection and management” [24]. This can be done by civil individuals as well as by authorities. Nevertheless, many things keep the city apart from the sustainable management of water resources. The first to be mentioned is the consciousness of the community. Local authorities and communities should cooperate, in order to reach the sustainable management of water resources.

## 5. Conclusions

Agenda 2030 for Sustainable Development is in its early stage - it is four years old by now. There are still many years for the Agenda to be accomplished.

In Europe, some countries are doing well towards sustainable development including the management of the water resources while some others fade in progress.

As the Republic of North Macedonia is a developing country, many things have to be done. Being under great influence of different factors, in general, the sustainable development and the sustainable management of water resources, in particular, are moving slowly. The legislation is in its place, a serious exertion is expected from the practical part.

The city of Gostivar has taken huge steps on water regulation in the city and its surrounding area with numerous projects foreseen for 2019. Nevertheless, many things keep the city apart from the sustainable management of water resources. The first to be mentioned is the consciousness of the community. Thus, local authorities and communities should cooperate, in order to reach the sustainable management of water resources.

Finally, it can be concluded that in the framework of sustainable management of water resources, decision-makers, experts and individuals should all take on corresponding responsibilities to raise civic consciousness and follow these challenges in a professional way. Namely, sustainable management of water resources integrates several connected fields such as protection from climate changes, quality of life, energy efficiency, etc. It also includes the consciousness of a society, policymakers, and individuals in managing water resources. Due to the importance of water management for sustainable urban development, it is recommended that spatial planning of the city and the management of water resources must be done parallelly.

## References

- [1]. Perlman, H. (2018). *How much water is there on Earth, from the USGS Water Science School*. [online] Water.usgs.gov. Available at: <https://water.usgs.gov/edu/earthhowmuch.html>
- [2]. Liu, J., Xu, Z., Chen, F., Chen, F. and Zhang, L. (2019). Flood Hazard Mapping and Assessment on the Angkor World Heritage Site, Cambodia. *Remote Sensing*, 11(1), p.98.
- [3]. Agensi, A., Tibyangye, J., Tamale, A., Agwu, E. and Amongi, C. (2019). Contamination Potentials of Household Water Handling and Storage Practices in Kirundo Subcounty, Kisoro District, Uganda. *Journal of Environmental and Public Health*, 2019, pp.1-8.
- [4]. Sustainabledevelopment.un.org. (2018). Transforming our world: the 2030 Agenda for Sustainable Development. *Sustainable Development Knowledge Platform*. [online] Available at: <https://sustainabledevelopment.un.org/post2015/transformingourworld>
- [5]. Sustainabledevelopment.un.org. (2018). *Goal 6.: Sustainable Development Knowledge Platform*. [online] Available at: <https://sustainabledevelopment.un.org/sdg6>
- [6]. Usgs.gov. (2019). *How Much Water is There on Earth?* [online] Available at: [https://www.usgs.gov/special-topic/water-science-school/science/how-much-water-there-earth?qt-science\\_center\\_objects=0#qt-science\\_center\\_objects](https://www.usgs.gov/special-topic/water-science-school/science/how-much-water-there-earth?qt-science_center_objects=0#qt-science_center_objects)
- [7]. Robert W. Kates, Thomas M. Parris, and Anthony A. Leiserowitz. (2005). What is sustainable development? goals, indicators, values, and practice. *Science and Policy for Sustainable Development*, issue of Environment, Volume 47, Number 3, pages 8–21. Available at: [https://sites.hks.harvard.edu/sustsci/ists/docs/whatisSD\\_env\\_kates\\_0504.pdf](https://sites.hks.harvard.edu/sustsci/ists/docs/whatisSD_env_kates_0504.pdf)



- [8]. Kanie, N. and Biermann, F. (2017). *Governing through goals*. The MIT Press.
- [9]. Adeel, Z. (2017). A renewed focus on water security within the 2030 agenda for sustainable development. *Sustainability Science*, 12(6), pp.891-894
- [10]. European Environment Agency. (2018). *Sustainable water management*. [online] Available at: <https://www.eea.europa.eu/themes/water/european-waters/water-management/overview>
- [11]. Water Strategy for the Republic of Macedonia. (2010). [http://www.moepp.gov.mk/wp-content/uploads/2014/12/Macedonian-water-strategy-final-draft-version\\_10092011\\_EN.pdf](http://www.moepp.gov.mk/wp-content/uploads/2014/12/Macedonian-water-strategy-final-draft-version_10092011_EN.pdf), Skopje.
- [12]. Organization of Consumers Macedonia (2018). "*Citizens active partner in water policy reforms*". Analysis of situation with water management in the Republic of Macedonia and consumer's rights protection. [online] Skopje: Center for Ecological Democracy Florozon Skopje. Available at: <http://opm.org.mk/wp-content/uploads/2018/05/ENG-STUDIJA-VODI-SO-KORICA-engl.pdf>
- [13]. Wiederkehr, F., Dodeva, S. and Mirta, Y. (2016). *Macedonia Draft SDG#6 Strategy*.
- [14]. Natasha, M., (2016). *Rapid integrated assessment and gap analysis*, Development of National SDGs Implementation Plan 2016-2030 and SDGs Action Plan 2016-2020.
- [15]. The former Yugoslav Republic of Macedonia 2018 Report. (2018). Commission staff working document. [online] Strasbourg: European Commission. Available at: <https://www.sobranie.mk/content/republic-of-macedonia-report%2017.4.18.pdf>
- [16]. Web.archive.org. (1996). *Macedonia FAQ: Gostivar*. [online] Available at: <https://web.archive.org/web/20001119171300/http://faq.macedonia.org/travel/cities/gostivar.html>
- [17]. Sustainable Development Goals Fund. (2019). *Goal 6: Clean water and sanitation*. [online] Available at: <http://www.sdgfund.org/goal-6-clean-water-and-sanitation>.
- [18]. Agreement, [2012], Agreement between the government of the Republic of Macedonia and the government of the Swiss confederation on the granting of a financial assistance for the project "Improvement of the Gostivar Water Supply System" 28 September 2012
- [19]. Report [2016], Variation order no 3, April 2016
- [20]. Report [2016], 6 October 2016
- [21]. The German Financial Cooperation with the Republic of Macedonia, Ministry of Transport and Communication, MoTC, Municipality of GOSIVAR started a new project named "Water and Sewerage Programme Macedonia", November 2018
- [22]. Berun, M. (2018). Public Health Center. Tetovo
- [23]. Elem. (2016). Elaborate for determining the capacity of the river bed of the river Vardar on the move from Raven to the bridge in Gostivar. (Елаборат за определува е на капацитетот на коритото на р. Вардар на потегот од се Равен до железнички мост во Гостивар).
- [24]. Forssberg, B., Malmqvist, P. and Söreljus, H. (2014). Process of change: Successful implementation of good water management practices in six cities. [online] *Siwi.org*. Available at: <http://www.sivi.org/wp-content/uploads/2016/10/SWH-Working-Paper-Process-of-Change-web-1.pdf>
- [25]. The city of Gostivar, North Macedonia, Source: [https://he.wikipedia.org/wiki/%D7%A7%D7%95%D7%91%D7%A5:River\\_Vardar\\_In\\_Gostivar.jpg](https://he.wikipedia.org/wiki/%D7%A7%D7%95%D7%91%D7%A5:River_Vardar_In_Gostivar.jpg)
- [26]. The river Vardar in the urban area of city of Gostivar, Source: <https://depositphotos.com/39344769/stock-illustration-map-of-macedonia.html>