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Urban water full cycle: from its source to its end-users and back to the environment

WP3 Transnational Current Situation Analysis
Joint Del. 3.3 Transnational Climate Change Impacts Assessment & SWOT Analysis

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PP4 - University of Thessaly-Special Account Funds for Research-Department of Civil Engineering

Project co-funded by the European Union and National Funds of the participating countries

WP3: Transnational Current Situation Analysis

- Responsible partner: PP4 - University of Thessaly-Special Account Funds for Research-Department of Civil Engineering
- Partners involved: ALL
- Budget: 77,817.51 €

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WP3.3: Transnational Climate Change Impacts Assessment & SWOT Analysis

- Climate Change Impacts Assessment takes place including transnational climate characteristics and scenarios and impacts of climate change on resources (energy/water) efficiency.

- The climate characteristics and climate change impacts are assessed at national and local / regional level with emphasis to the climate change impacts on water and energy resources.

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National Level – General description

- Greece is situated on the southern tip of the Balkan peninsula and it shares land borders with Albania, FYROM, Bulgaria and Turkey. Its total population is 10,815,197 people (2011 census) and its area is 131,957Km^2. Greece consists of 14 Water Districts, 46 river basins, 1,785 surface water bodies and 565 groundwater bodies.
- North Macedonia has a population of 2.081 million inhabitants (2016) and the population density is 82.52 people per Km^2. There are three river basins in FYROM: the Aegean, the Adriatic and the Black Sea basin.
- The population of Bulgaria as of 2016 is 7.127 million people and the average density is 64.21 people per square kilometer. There are 4 River Basin Districts identified in the country: Danube RB, Black Sea RB, East Aegean RB and West Aegean RB. There are 32 rivers and more than 400 lakes in Bulgaria.
- The Republic of Albania is located in southeastern Europe, in the western part of Balkan Peninsula facing the Adriatic Sea and the Ionian Sea. Albania has a surface area of 28,745 km^2. Its terrain is mountainous, where hilly and mountain regions represent 77% of the country's territory. The climate of Albania is typically Mediterranean. Albania is divided in six (6) river basins.
- Cyprus is an island in the eastern part of Mediterranean Sea. Its population is about 850,000 people (2014). The country has 20 groundwater bodies in one river basin

National Level – Climate characteristics (1/2)

Greece:

- the climate is mediterranean, with mild and wet winters in the southern lowland and island regions, cold winters with strong snowfalls in the mountainous areas in the central and northern regions and hot, dry summers.
- In the Mediterranean climate frame, there are many climate subtypes in several regions of Greece.
- From October to March, the coldest months are January and February, with, on average, mean minimum temperature ranging between 5 -10^{o} C near the coasts and 0 – 5^{o}C over mainland areas, with lower values (generally below freezing) over the northern part of the country.
- The warmest period is the last ten-day period of July and the first one of August, when the mean maximum temperature lies in the range of 29.0 and 35.0^{o}C.
- The rainfall pattern typical of Mediterranean coastal areas is predominant, with dry spells in summer and a rainy season from mid-autumn to mid-spring.
- Mean annual precipitation for Greece is roughly estimated at 800 mm, but the geographical distribution of the annual amount of precipitation and of the yearly rainy season generally follows Greece's geomorphology.

The climate in **Cyprus** is generally characterized by mild rainy winters, occasional droughts, and long, hot and dry summers.

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National Level – Climate characteristics (2/2)

Bulgaria:

- temperature values show an increase in general.
- In the period 1988-2015 the average annual temperature of air for the lower part of the country (for areas up to 800 meters above sea level) has risen with average 0.8°C compared to the norm of the reference climate period 1961-1990.
- Average annual temperature is 10.5°C.
- Precipitation values in 2015 (for areas up to 800 meters above sea level) are 689mm.
- Climate change scenarios showed that positive tendencies are observed in the whole country regarding temperature. Specifically, the temperature increase is expected to be about 1,5-2°C for the near future and 2,5-3,5°C for the far future. Annual precipitation is distributed in space. Negative tendencies are expected in Eastern Bulgaria. Climate change scenarios are developed for Bulgaria. Greenhouse gases emissions are expected to decrease in the future.

Albania:

- The average annual temperatures vary from 17.6°C (in Saranda to the South) to 7°C (in Vermosh to the North). Temperature trends are increasing since 2000 for all seasons (winter: from +1.6 to +2.5°C; spring: from +2.0 to +3.0°C; summer: +3.0°C; and autumn: +2.0°C).
- Some regions concentrated primarily on the north, west and southwest regions of Albania are characterized by high amounts of rainfall, with an annual average amount of 1430 mm. However, the spatial and seasonal distribution of rainfall varies; most rainfall occurs during the cold half of the year (70%). Since 2000 precipitation trends are increasing. Analysis of seasonal precipitation patterns shows no consistent patterns in variation with periods above and below normal values.

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National Level – Water availability & demand (1/2)

- Greece:
  - Annual water demand is 9,990hm^3 (2017 data).
  - Agriculture is the main water consumer, using 81.53% of the total water demand, followed by domestic water use 15.25%, industry 2.42% and livestock farming 0.8%.
  - Climate change is expected to have impacts to both water and energy resources. Regarding water resources some of the impacts are: decreased aquifer infiltration and recharge; increased water resources evapotranspiration and increased water demand; salinization phenomena; increased pollutant load concentrations in coastal water bodies; droughts; etc. Regarding energy resources, the impacts include: reduced efficiency of thermo-electrical units; increased loss on electricity distribution networks; increased electricity demand in the summer; etc.
- North Macedonia:
  - the main problem arising in the field of availability of water resources is the uneven spatial and timely distribution over the country, showing altogether more favorable conditions in the western part, but being characterized over all the national territory by a timely distribution which presents long drought spells and high intensity rainfalls which constitute at the same time a threat for crops and which prone erosion phenomena.
  - About 85% of the surface water origins in the country, while only 15% of the water is inflowing to the country from the neighboring countries.

National Level – Water availability & demand (2/2)

- Bulgaria:
  - the dominant water user when surface water is examined is industry (48%) followed by irrigation (33%).
  - For groundwater, the dominant user is drinking water supply (79%).
  - Water demand in expected to increase in total by 4.5% from 2010 to 2035. Black Sea RB and East Aegean RB are expected to face the greater increase in water demand.
  - Climate change is not expected to affect dramatically water resources. At RB level, Danube RB is expected to face low risk and Black Sea RB and East Aegean RB are expected to face medium stress.
- Cyprus:
  - WEI levels show that significant problems exist in the water resources in Cyprus.
  - Nowadays desalination plants are used for the supply of drinking water.
  - The major water user is agriculture.
  - The decrease in the available water resources in Cyprus due to climate change has caused in past severe restrictions in the supply of water for domestic and irrigation uses. Also, costly measures were implemented for securing the absolutely necessary quantities of potable water (e.g. by importing water, intensifying the desalination plants operation).

National Level – Land uses

- The dominant land use in Greece is forests (27.68%) followed by semi-natural vegetation (26.22%) and arable land (23.12%). Mitigation and adaptation measures are set by the competent authorities to address the climate change impacts in Greece.
- In North Macedonia, the dominant land use is agricultural land (44.3%), followed by forests (39.8%).
- In Albania, the main land use is forests (36%), followed by arable land (24%).

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Regional Level – Climate characteristics (1/2)

- LP - DEYAL
  - The Municipal Water Supply and Sewerage Company of Larissa (DEYAL) is located in Thessaly region, in the eastern part of central Greece.
  - Thessaly region covers an area of 14,037 km^2 and its population is 732,762 (according to the 2011 census).
  - Most of the area of Thessaly region is part of the Water District of Thessaly (EL08), consisting of two river basins: the river basin of Pinios (area 11.062 km^2) and the river basin of Almiros – Pelio streams (area 2,079 km^2).
  - The climate in Thessaly region can be characterized by mild to intense winters, mild springs with reduced rainfall and low temperatures, dry summers with increased temperatures and mild autumns with increase in rainfall and humidity. The monthly average temperature ranged from 5.2^oC (January) to 27.1^oC (July) at the period 1971-2000, showing an increasing trend. Mean precipitation values ranged from 18.6mm (August) to 63.7mm (November) in 1971-2000, showing a slight decreasing trend. Climate change is expected to impact on water resources in Thessaly region. Precipitation levels are expected to decrease at annual level, while the number of warm days is expected to increase.
- PP3 - DEYAK
  - The Municipal Water Supply and Sewerage Company of Kozani (DEYAK) is located in Western Macedonia.
  - The WD of Western Macedonia includes two RBs: Prespa and Aliakmonas. Prespa RB covers an area of 1,210 Km^2 and Aliakmonas RB covers an area of 12,410 Km^2.
  - 4-month period temperature ranges from 5.5^oC to24^oC (2005-2012) showing a rather stable trend, while precipitation trend is increasing.

Regional Level – Climate characteristics (2/2)

- PP5 - UKKO
  - Korçë County is located in the eastern part of Albania. The population at the 2011 census was 220,357 and the area covered is 3,711 km².
  - Korça region includes the districts of Devoll, Kolonja, Korca and Pogradec. Semani river basin (where Korce belongs) covers an area of 5,649Km^2.
  - Precipitation and temperature levels remain almost stable since 2006 in Korce.
- PP6 – WBN
  - Nicosia is the capital city of Cyprus with population of about 290,000 people (served from WBN). The area covered is 91Km^2.
  - For many years, the precipitation in Cyprus is decreasing due to climate change. Temperatures increase and water supply is mostly dependent on desalinated water produced in treatment plants. Thus, Nicosia supplies water that is mainly produced at desalination plants.
- PP8 – JKP ViK Prilep
  - The Municipality of Prilep has relatively poor water resources. Therefore, the drinking water supply is carried out by the regional water supply system Studencica, whose source is outside the Municipality of Prilep.
  - The population supplied with water is 74,121 people. Annual water consumption is 3,396,871m^3 per year.
  - The climate in Prilep is moderate – continental climate. The average annual minimum temperature at the measuring point in Prilep is 6.1 °, while the absolute maximum temperature is up to 39.4 °C. The small amount of precipitation during the year (500-600 mm) is the cause of the poor water resources.

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Regional Level – Water Availability & demand

- LP: The main water user in Thessaly is agriculture (93.1% of water use), followed by domestic water use (5.6%) and livestock (0.8%). Overexploitation of groundwater resources is found in two out of the three groundwater systems supplying Larissa city with water, which are assessed to be in bad quantitative status, and one of them in bad chemical status. Based on the WEI index calculated for the three aquifers, the system Taousani – Kalo nero is not sustainable at its present state and only if water demand decreases and renewable water resources stay the same or increase, the system will face strong risk. Titarisios cone system faces strong risk at its present state while the system Damasiou – Titanou is possible to face difficulties if water demand increases and renewable water resources decrease.
- PP3: The dominant water user in Western Macedonia WD is agriculture. In Western Macedonia WD, 43 out of 55 groundwater bodies have good quantitative status. 11 groundwater systems are supplying with water the city of Kozani. Only two of them are in bad quantitative status, presenting WEI values greater than 1 (not sustainable). The other two systems SW Bermion mountain and Central-East Bermion mountain do not face water exploitation problems.
- PP5: The annual water consumption in 2017 was 2,423,813m^3 in Korce. The estimation of WEI index revealed that no possible problems are expected for the water resources in the area of Korce.
- PP6: WEI levels show that significant problems exist in the water resources in Cyprus. Nowadays desalination plants are used for the supply of drinking water. The major water user is agriculture. The decrease in the available water resources in Cyprus due to climate change has caused in past severe restrictions in the supply of water for domestic and irrigation uses. Also, costly measures were implemented for securing the absolutely necessary quantities of potable water (e.g. by importing water, intensifying the desalination plants operation).
- PP8: WEI indices for the Prilep showed that there are no problems with water resources availability. No water protection areas are designated.

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Regional Level – Water Quality & protection zones

- LP: Point pollution sources identified in the RB of Pinios, are wastewater treatment plants, sewerage networks discharging to physical receivers, large hotels, industries, livestocks and aquaculture and fishfarming. The most polluting activity is livestocks, followed by industries and wastewater treatment plants. Diffuse pollution sources include urban, agricultural, livestocks and other sources, with livestock being the most polluting activity followed by agriculture (for nitrogen loads). The systems of Taousani – Kalo nero and Titarisios cone face local pollution problems due to agriculture (increased NO_3 values), industry, over-abstraction and urbanization. Agriculture sets pressure to all three systems. The system Damasiou – Titanou is characterized as water protection area for drinking water supply. Two measures in the Programme of Measures of the RBMP of Thessaly refer to the designation of protection drinking water supply zones.
- PP3: In Western Macedonia WD, 11 groundwater systems are supplying with water the city of Kozani. Only two of them are in bad qualitative status. Water protection zones are identified as recreational waters, areas sensitive to nutrients presence, areas intended to protect aquatic species of economic importance.
- PP5: Some microbiological problems are met in drinking water in Korce water utility, which are solved by chlorination process. Coastal water resources are threatened by saltwater intrusion. Other problems in quality include the significant pollution by nitrites and ammonia, including the Vjosa and Mati (northern part) aquifers and Uji Ftohte (Vlore) and Potami (Himare) springs. Sanitary protection zones are established by law.

Regional Level – Land uses

- The main land use in Pinios RB is agriculture (43%) followed by forests (27%) and pasture (23%).

- The main land use is forests (56.5%) followed by agriculture (39%) in Western Macedonia WD.

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