Importance and use of thermal water in health, environmental and social aspect

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Abstract

Thermal waters are a great asset that gives us land for the development of an area in terms of curative, economic, social, and political, but it has important uses in the health sector for the treatment of various diseases. The assessment of these waters and their levels of pollution is done by studying the physical, chemical, and biological properties. The permissible standards for each of the indicators depend on the purpose of the water use. In Albania, geothermal springs such as thermal waters are mainly used for curative and tourist effects. Although these waters have a potential for energy use it has not yet started to be used. The springs of Elbasan Spas are the most famous thermo-mineral springs of Albania. This research aimed to evaluate the role of natural and mineral resources in health, environment, and recreation, tourism, etc. In the Elbasan area, two sources were collected for the collection of thermal water samples, allowing the analysis of physicochemical parameters and comparison of the results found. The results showed that the average value of temperature in two places of thermal water is up to 58.3. C, which is very high for the flora and fauna where these waters are discharged. Estimated values of H2S, CO, sulfates, calcium, nitrates, magnesium, and phosphates are statistically significantly different in sampling. In the study area, the thermal waters flow in nature, on the surface of the soil, and in the streams around the springs and Lake Tregan. Based on the results these waters must be purified before being sent to the drainage system and in streams, rivers, and lakes or newly injected underground into geothermal reservoirs. These sources are visible for very high levels of parameters seen in the analyses performed. Compared to the first average-in-1995 analysis of values in the two supply sources that we have reduced in their content for the period April 2019.

Keywords: Physical-chemical parameters, healthy effect, thermal water, Elbasan area, Sulfate.

I. Introduction

The water used to supply the population, which can be obtained from underground springs, is unfortunately not insufficient for the plot of needs at the population level (Kullaj, 2014). Geothermal water springs are waters that originate from the underground, at a temperature significantly higher than the air temperature of the surrounding region. Most of the thermal water flows out from groundwater. The temperature of the water rises from the magmatic activity and volcanic area. However, some thermal springs are not related to volcanic activity. In the case of working, water

is heated by the circulation of groundwater flowing down to the ground and reaching depths of one kilometer or more, where the rock temperature is higher due to the normal gradient of Earth crust temperatures - about 30 ° C (54 ° F) per kilometer at 10 km ago (Britannica, 2017). The terms Water are a great asset that gives us one by one area in terms of curative, economic, social, and political (Cox, 1986). The assessment of used waters and their levels of pollution is done by physically studying chemical, chemical and biological. The standards for each indicator depend on the purpose of water use (Sandoyin, 1991). The terms Water are much more appropriate for temperatures, the amount and types of salts, the amount and types of gases that meet them, the radioactivity, etc. Those used to heat homes do not go directly from source to consumer to be stored in warehouses. In Albania, geothermal resources are used only for effective and tourist effects. Thermal waters have gain temperatures up to 60 ° C. Thermal water in Elbasan implies a great asset of the village of Tregani as most of the income of the population comes from the use of these waters in the balneological centers. The Administrative Unit of Tregan consists of 12 villages and reaches a population of 4530 inhabitants (Census 2011, INSTAT). Numerous vacationers visit the curative thermal water springs in the numerous hotels or private homes of the area, which provide services to vacation patients from all over the country and beyond. Their number reaches about 30 thousand a year. The population in these villages is mainly engaged in agriculture where orchards, livestock, and viticulture stand out. Tregan Administrative Unit is located 12 kilometers away from the city of Elbasan and has been declared a Tourist Zone by Decision of the Council of Ministers No. 88, dated 01.03.1993 which defines two tourist zones: 1) Llixha Center area with an area of 54 hectares. The springs of Llixha Center are located in the stream of Prifti, about 1.2 km northwest of the peak Guri I Këçikut (351.0 m). 2) Llixha- Hidraj area with an area of 9.5 hectares. Thermal water in Hydra is located in the Banja stream, about 1.5 km southeast of the first spring group. The most prominent geomorphological phenomenon of the area is the range of hills located on the western side of the springs of Llixha. The highest peaks of this hilly range with a height of up to 350 m, are built of limestone which is surrounded by flysch formations.

There are a total of 20 sources and their grouping is done according to the description of (Avgustinski VL, 1957). The total flow of Spa resources is about 15 l / s and this flow seems to be maintained even today. The state of thermal waters is in natural conditions until 1998. Later their privatization, illegal and uncontrolled construction completely changed the situation. Nowadays it is almost impossible to find most of the sources according to Augustinski's initial description; everything is hidden inside the catchments which are placed without planning. They are consecutive and technically controversial. Hydra's resources are a total of three; they emerge on the southern slope of the Kyçyka peak to the Banja stream. The total flow of Hydraj springs today is about 13-14 l / s versus about 28 l / s given by Avgustinski. The natural state of Hydraj's resources which was preserved until about 1997 is now completely altered. Their presence in the natural landscape of the Spas, together with the thermo-mineral springs, constitute two separate and inseparable elements of it. The travertine hills faithfully testify to the chemical composition and geological history of the thermo-mineral waters and remind all visitors of the presence of thermal waters with very

special chemical qualities. The most suitable temperature for curative baths is around 34 to 38 ° C.

Since the springs of the Spas of Elbasan and Hidraj have a higher temperature, they are cooled before use in some open tanks where the water temperature drops above 50 ° C to about 38-36 ° C. During the cooling of the water, a part of the hydrogen sulfide gas is removed and its content decreases from about 350-400 mg / l to about 150-200 mg / l, an amount that is very optimal for curative baths. According to the data of the Curative Center of Elbasan, thousand of patients are treated in a controlled manner every year (Bojadgieva K., 2002).

II. Materials and methods

This study practically deals with the evaluation of the role of natural resources such as thermal waters in tourism, health, and recreation, based on the case of spas in Elbasan.

It also evaluates the qualities and characteristics of thermal waters in the area, according to national and international standards. The focus is to identify the parameters and indicators of the thermal waters of Elbasan, their impact on the environment and health, and recommendations for the most efficient use of these waters. The assessment of thermal waters in the area was performed through physicochemical analysis and comparison of these studied indicators with international standards. Laying out different methodologies for the use of thermal springs to use the maximum potential of these waters.

The study was conducted in the administrative unit of Tregan during the period October 2018-June 2019. The study was conducted to assess the thermal waters of Elbasan and its impact on the area. Water sampling is based on APHA 2005 and USEPA 2001 standards. Water is taken in sterilized glass bottles, so as not to be affected by the holding material. After collection, the samples were transported in closed containers at a temperature of 4 ° C in terms of boxes at the site of analysis overnight, in the Laboratory. The results obtained from the analysis, are compared with the norms of indicators set by FAO 1989, for the assessment of thermal water quality.

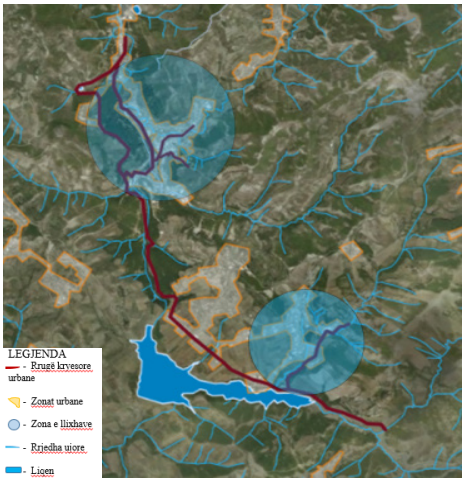


Figure 1. Sampling place in the area of Elbasan thermal water.

Geothermal energy is a source that can be used for direct heating or the production of electricity. The areas of its use are schematically given in the following figure (Steingrímsson, 2007). The areas, where geothermal sources can be used, are conditioned by their temperature. If we were to make a schematic representation of use depending on the temperature, we would have a scheme similar to that given in fig. 2. (Lìndal, 1993).

Fig.2 Llixha Hidraj, before and afer '90

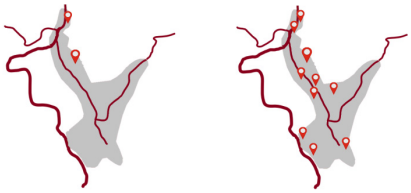


Fig.3 Llixha Center, before and afer '90

III. Results

The use of thermal water began in 1932 when the first hotel was built. During the period 1965-1970, other hotels began to be built in "Hidrajt" springs with specialist personnel.
After the '90s, the construction of functional houses to receive vacationers from all over
Albania, from the areas of Kosovo and Macedonia took off. After the '90s there was a chaotic development, all resources are used without exception, with very simple and primitive conditions.
The land cover in the study area consists of:

- Mixed forests
- Fields of grass
- Agricultural products
- Land with permanent irrigation
- Forests

Grass fields and forests predominate in this area.
From the achieved results, the interpretation of each physico-chemical parameter has been compared and with the standards defined in the study.
In water, temperature directly affects all metabolic and physiological processes of organisms such as nutrition, reproduction, movement and distribution of organisms (Swami & Udhayakumar, 2007). During the study, changes in atmospheric temperatures ranged from 16.8 °C while the temperature of the thermal water samples resulted in average values for both stations of 58.3 °C. These waters with such high temperatures presented in figure 5, flow directly into surface waters affecting the flora and fauna of the zone. From the balneological point of view, the thermo-mineral waters of the sources in Elbasan are part of the hyperthermia group, which is the group of waters whose temperature is above the temperature of the human body. From a geothermal point of view, this water belongs to the hydro geothermic springs of low enthalpy (fluid temp is <100 ° C).
Thermal waters have a high level of conductivity due to the salts contained in water. Conductivity values are above 3 DSS / m, which means that the content of salts

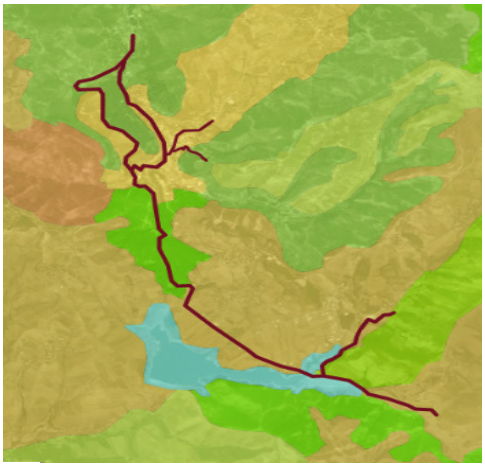
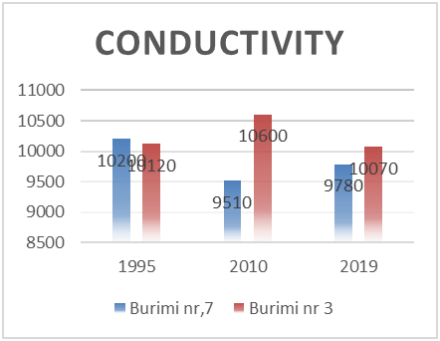


Fig.4 Land cover in the study area

dissolved in them is above the allowed norms. High conductivity negatively affects plant growth because it is closely related to the salt content in water, (Israeli et al., 2008). In the analysis of thermal waters in the samples, the conductivity varies in the values 9780 μS / cm - 10070 μS / cm. If we compare them with the studies and analyzes of the period 1995-2010-2019 it seems that the values do not have a significant change since the analyzes have been done in different stages and the electrical conductivity varies with the fact of heavy rainfall during the winter-spring period, coming from the melting of snow, these amounts of water, which cause the number of dissolved salts to decrease.



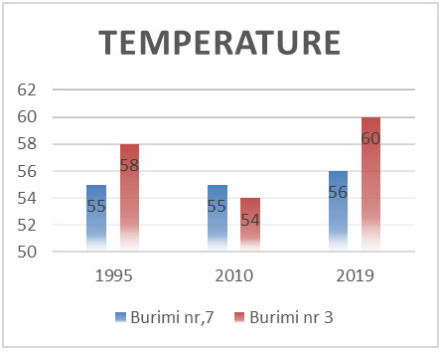


Figure 5. Temperature and Conductivity content in the period June 2018- April 2019, (compared to the values studied in 1995, 2010).

The pH analyzed in two samples taken in the field at two predetermined springs varies from 6.7 - 6.84. Therefore, these waters are neutral thermal waters. The pH in the thermal waters of Elbasan is balanced as the salts dissolved in these waters are considerable and the balance of anions and cations makes these waters more balanced (Chaplin et al., 1987). The pH is within the standards norms of irrigation water, according to FAO standards. If we compare the analyzes of the years 1995-2010-2019, we see that we have no changes in the Ph of water during these years. Usually solid waste can be found in nature in a dissolved form, then decomposes into positively and negatively charged ions. The presence of these dissolved solids directly increases the value of salinity and conductivity as salinity is a measure of the number of salts in water and conductivity is the ability of water to conduct an electric current with dissolved ions as conductors. The dry matter content in the thermal waters of Elbasan ranges from 7135.7 mg / l to 7134.6 mg / l.

According to the change during the years 1995-2019, its values range from 6805mg / l to 7135.7 mg / l in the spas "Park Nosi" and from 6745 mg / l to 7134.6 mg / l in the spas "Hydra". We notice an increase in values in terms of dry waste in the waters of

the spas of Elbasan.

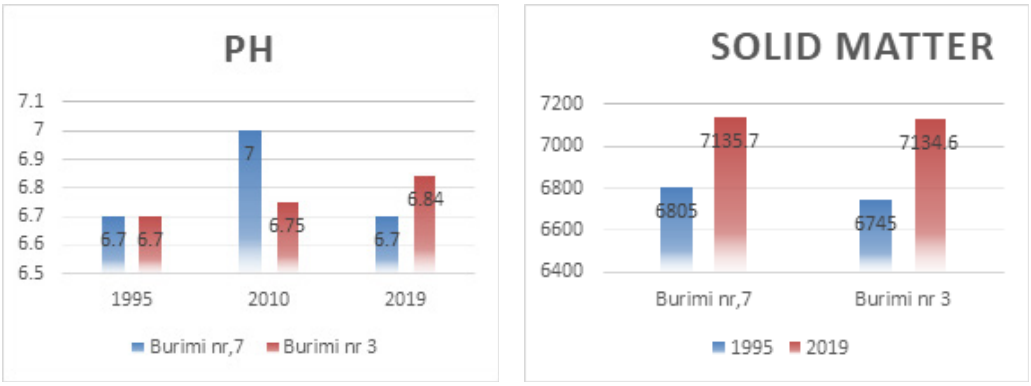
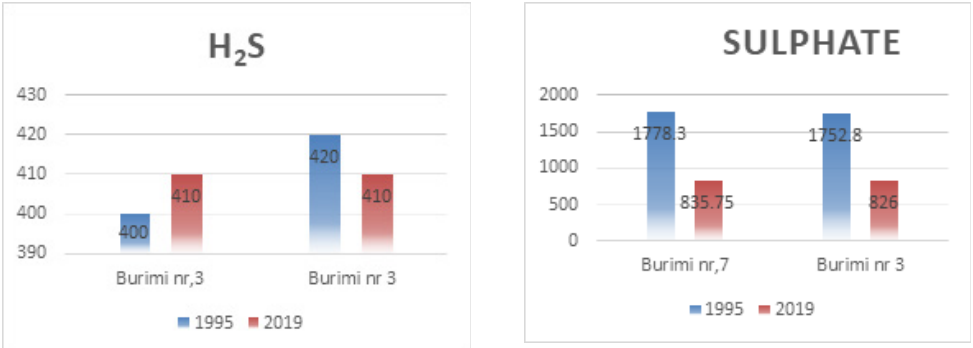


Figure 6. pH and solid matter content in the period June 2018- April 2019, (compared to the values studied in 1995, 2010).

In terms of H2S content, we have no changes over the years and both sources have less than 1g / l H2S. Figure 7, shows that the average values of H2S go below the value of 410 mg / l, resulting in the limit allowed according to the standards obtained in the study. However, it is always an environmental concern when allowed to accumulate in water bodies. In industrial processes, the corrosive effects of H_2S on the water often require control at much lower concentrations to protect equipment. The water sulfate content of thermal springs varies between 835.75 mg / l and 826 mg / l. These springs are noted for very high sulfur levels as seen in the analyses performed. In the first analyzes carried out by Avguinski in 1995, the values in the two sulfate sites ranged from 1778.3 mg / l to 1752.8 mg / l. As can be seen in figure 4, we have a decrease in sulfate content during the years 1995-2019.



F*igure 7. Hydrogen sulphide and sulphate content in the period June 2018- April 2019, (compared to the values studied in 1995).*

Calcium is a very important element in assessing water quality as it is closely related to water hardness. From the results achieved in the study, it was observed that calcium is among the elements found at very high levels in the thermal waters of Elbasan. Values range from 889 mg / l to 928 mg / l in 2019 in the analyses performed. In the years 1995, the analyzes made the values in the springs "Park nose" and "Hydra" the values vary from 403.4 mg / l to 408.3 mg / l. The Ca content in the thermal waters of Elbasan has been decreasing.
Magnesium is another important element, which is valued and affects the quality of thermal waters. The performance of its content in thermal waters during the years 1995-2019 is presented in figure 8. There are no changes in the composition of water in terms of magnesium content over the years. The level of magnesium content is higher in source no. 3 in "Hydraj" spas. The analyzed values range from 186 mg / l to 196 mg / l.

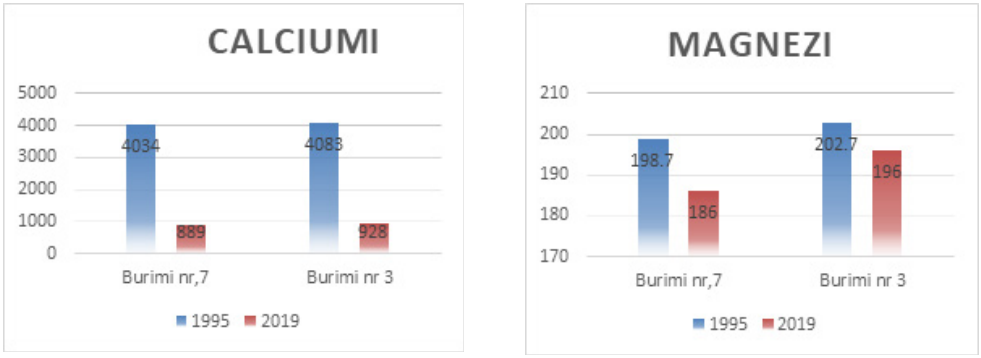


Figure 8. Calcium and magnesium content in the period June 2018- April 2019, (compared to the values studied in 1995).

From figure 9, it is clear that sodium is found in very high content, many times above the allowed norms in the thermal waters of Elbasan. Its content in the average values for both stations goes 1190 mg / l.
Based on the results found in the study, we estimate that sodium during the study period has resulted above the allowed norms which go tens of times more. This fact shows that the thermal waters of Elbasan are classified as waters with very high sodium content, making these waters very dangerous when used for irrigation or for the flora and fauna of surface waters where they are discharged.
The study shows that the nitrate content is at low intervals compared to the allowed values. The average values of nitrates for the study period in both springs of water samples taken in the analysis go to 2.67 mg / l. The ammoniacal nitrogen content for the years under study is given in the graph below. For the study period, the average values of the two sampling sites were 0.275 mg / l, thus indicating that the result obtained was within the allowed norms (below 5 mg / l). In 2019 we see that we have a decrease in ammonia in water.

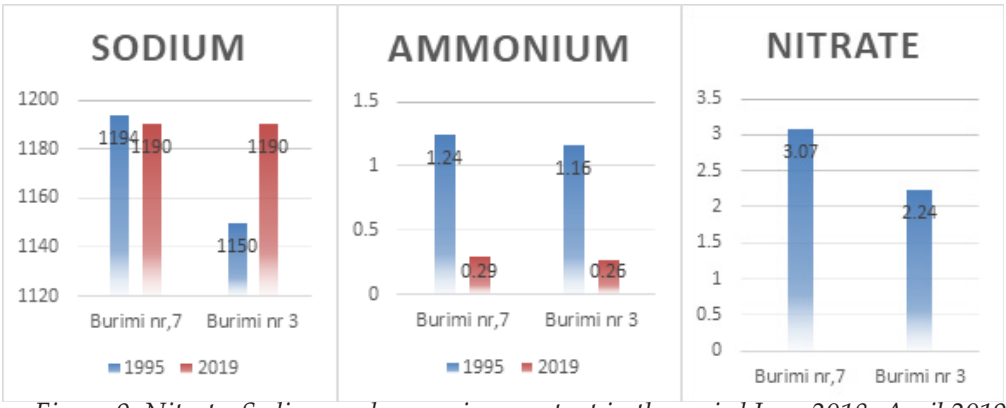


Figure 9. Nitrate, Sodium andammonium content in the period June 2018- April 2019, (compared to the values studied in 1995).

The use of thermal waters is also related to the problems of protection and preservation of the environment. In the study area, the thermal waters flow in nature, on the surface of the soil, and in the streams around the springs and Lake Tregan. The surface water must be treated before it is sent to the drainage system and streams because it can contaminate groundwater which is used as drinking water, industrial, or biodiversity depletion.

Figure 10. Current environmental situation from the discharge of thermal waters

In the Elbasan area, the thermal waters contain an average of 7.1 g / l solid waste. The vegetation around these areas has an obvious disadvantage because the salinity in the water is high making it toxic. Some plants are more sensitive to high values of electrical conductivity. Each plant species has an allowable electrical conductivity threshold, beyond which production decreases. The sensitivity of plants to high values of conductivity (high values of water-soluble salts) is especially high when plants are at a young age. It is therefore important to plant special plants around these areas.

IV. Discussions

Based on the above results we conclude that thermal waters have a great impact on quality indicators of water use in health but also in irrigation. The temperature of the main thermal springs ranges from 50 to 60 °C, which classifies them as "very hot". Water has a "slightly acidic" reaction or is "neutral", the pH fluctuates around 6.7 to 6.8. The springs of the Spas of Elbasan are classified with "average salinization" as the

dry residue in most of the springs fluctuates around 7135.7 mg / l. The hydrochemical type of water according to the predominant compositions according to the analyzes performed is "chloride - sodium sulfate - calcium". According to the sulfide content, the thermo-mineral springs of the spas are classified as "very strong sulfides". The content of free carbon dioxide (CO2) fluctuates around 160-180 mg / l and thermo-mineral waters are classified as "weak carbon dioxide". The presence of carbonate ions that are not dominant in thermo-mineral waters is caused by the stable pH value. These waters according to the analyzed TDS enter are named "slightly salty waters. They are part of the sulfur springs as they hold a large amount of sulfur. The most significant of all the gases in the thermo-mineral waters of the area is hydrogen sulfide. Its healing amount is caused by the content of hydrogen sulfide ions and free hydrosulfide. Sulfur thermal springs offer health benefits when used in balneology and cure skin diseases, kidney, respiratory problems, gastritis, rheumatism, eczema, and have to calm, relaxing, and stress-reducing effects.

The thermal waters of Elbasan have a very high content of calcium and magnesium and are also classified as "dangerous" and for the high content of sodium.

Sulfates and bicarbonates are found in very high contents in thermal waters. Since carbonates form insoluble salts in the soil, they negatively affect the flora and fauna of the discharge of these waters to the surface ones.

V. Conclusions

Elbasan thermal springs are used only in the health tourism sector. The potential of these springs is not fully exploited as they meet all the necessary parameters (temperature, pressure, etc.) for other uses such as home heating.

Elbasan spas are the main economic resource in the administrative unit of Tregan as about half of the population deals with the activities of hotels and spa centers, therefore it is necessary a better tourism planning in European standards.

Sulfates also make thermal waters dangerous, affecting plants and humans when (humans) are exposed for a long time to sulfur vapors in the environment around the thermal water source. Based on the values found in the study, thermal waters are not dangerous in terms of nitrate and ammonia content. The thermal waters of Elbasan spas have a very high salt content and are classified as high-risk waters.

Albania's geothermal springs are classified as low to medium enthalpy springs and have only one surface steam source. Identification, analysis, and assessment of the state of thermal water quality in the study area allow us to give some suggestions or recommendations for ensuring the best possible water quality, increasing their use and impact on healthy humans. This study recommends an integrated water resources management plan, which will require the involvement of all actors who will follow together with the path to better functioning for the use of these waters in improving health.

Their regular monitoring should aim at implementing the criteria and achieving the standard parameters set by the national and international bodies. Initially, I recommend that these natural resources, of hot thermal waters, be returned to protected places, where more importance is paid to their maintenance or proper functioning in health, welfare, tourism, etc.

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