THE SUSTAINABLE USAGE OF GEOTHERMAL SOURCES AND THEIR IMPORTANCE IN TOURISM IN AFYONKARAHISAR

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Abstract:

Human beings have used geothermal sources since ancient times and are still using. Afyonkarahisar is one of the cities in which thermal sources are increasingly used in tourism. The aim of this study is to present the importance of geothermal sources in terms of tourism and their sustainable usage, and these sources constitute the most attractive part of Afyonkarahisar' tourism. Investments on tourism in this city as increased recently as well as unplanned urbanization and environmental problems due to the uncontrolled and excessive usage of thermal water. Unproductive and inefficient usage of thermal water jeopardizes the sustainability of sources. Necessary precautions should be taken such as the protection of thermal waters, drilling and distributing it from one single place and preventing illegal drills, since the future of tourism in the city depends on geothermal sources.

Key words: Tourism, Geothermal Sources, Sustainability, Afyonkarahisar.

INTRODUCTION

Geothermal energy is in the form of sensible heat that originates within the Earth’s crust and makes its way to the surface conduction. Heat may be conducted upward through solid rock or carried up by circulating ground water that is heated at depth and returns to the surface. Concentrated geothermal heat sources are usually associated with igneous activity, but there also exist deep zones of heated rock and ground water that are not directly related to igneous activity (Strahler and Strahler, 2002). The heat source from the depths of earth’s crust is related with a young volcanism or a mass of magma that has not finished cooling. The meteorite waters, flowing through the depths from the fractures and cracks in the earth’s crust, after warming up from this heat source and enriched in mineral, raise and gather in porous and permeable reservoirs found in the various depths of earth and controlled by impermeable seal rocks. This liquid constitutes thermal waters by coming up the surface following the routes that the fractures and cracks carved out or is drilled out and presented to the economic usage.
Furthermore, hot and dry rocks found in some areas, although they do not involve any liquid, are also characterized as geothermal energy source (Dickson and Fanelli, 2004).

Studies conducted so far revealed that Turkey is among the countries with rich geothermal sources. Today, Turkey has 8% of world’s geothermal potential. Turkey, with this potential, comes 7th in the world and 2nd in Europe after Italy in terms of richness in geothermal sources (Karabulut, 2004). In our country, there are hot water sources in East Anatolia in Çiftehan (Pozantı), Çermik (Diyarbakır), Muş, Erzincan, Pasinler, Dumlu (Erzurum), İlica, in West Anatolia in Gediz Graben, İzmir, Çeşme, Pamukkale, Bursa, Yalova, Afyonkarahisar, Haymana, Nevşehir, Açıkgöl, Kızılcahamam, and through North and East Anatolia fault lines. These sources are formed by the water leaking underground trough fault lines and coming out to the surface after becoming warmed and enriched in mineral (Atalay, 1994).

The practical usages of geothermal sources for bathing, washing and cooking trace back to the Prehistoric ages. Persians, Romans, Indians, Mexicans, Chinese and Japanese benefited from hot water in the ancient times. Japanese made use of thermal waters in cleaning their bodies. In addition, Romans used them for entertainment. In medieval ages, Turkish people and used and popularized traditional thermal public baths also known as Turkish bath (Barbier, 2002).

Hot springs containing large quantities of minerals dissolved from the surrounding rock are sometimes called mineral springs, and the mineral water may be used for medicinal purposes. Although it is very pleasant to sit in the hot water of a mineral spring or bath, this is one of the least important uses of water (de Blij and Muller, 1993).

Today, production amount and usage areas of geothermal sources have increased, while the production amount was low and the usage areas were limited in the past. There are many usage areas of geothermal sources. It is used in various areas such as electricity production, heating, health, agriculture, industry. The same geothermal water is even used in some different areas in order to increase productivity and decrease the cost. For instance, by using the hot water used in tourism in geothermal greenhouses, the productivity of water is increased (Kervankıran, 2012).

Thermalism, one of the branches of health tourism, is a tourism type that includes the transportation, accommodation and hosting needs of tourists for the usage of cold and hot mineral waters for health by drinking or by external application. Defined as “healing waters” colloquially, the ones who drink from these sources call them mineral spring and the ones who apply these waters externally call them hot spring and public bath. These are called as “spa center” or “thermal center” in tourism (Doğaner, 2001).
Natural waters that are beneficial for human health and have healing effects for some illnesses in their chemical and physical compounds are called “healing waters”, and the application of special health cures prepared by these waters is called “thermalism”. This type of health tourism is a tourism movement that healing sources and healing waters brought out. This movement generally depends on thermal spring and the application of mud and drinking cures (Doğanay, 2001).

The geothermal energy potential of Afyonkarahisar, the field of study, is high because of its geologic structure. Thermal sources on the fault lines along N-S and NW-SE help the economic development of the field of study. The geothermal sources take an important place in the reputation of Afyonkarahisar being known as “city of thermal springs” since the ancient times and today they especially contribute to the touristic development of the city. Afyonkarahisar, in which alternative tourism studies have increased along with thermal tourism opportunities, is one of the leading cities of Turkey in terms of tourism investments. There are also various types of tourism other than thermal tourism such as cultural tourism, eco-tourism, faith tourism, sports tourism, congress tourism, tableland tourism, and battlefields tourism.

Thermal sources constitute the most significant natural attractions in the study field and there are four thermal tourism centers (Gazlıgöl, Ömer-Gecek, Sandıklı-Hüdai and Heybeli) that The Ministry of Culture and Tourism have determined (Map 1). It is observed that thermal tourism investments offering more comfortable, more modern and both vacation and health services are increasing day by day compared to the traditional Turkish bath facilities. In addition to these modern facilities, there are places carrying on the classic hot spring business.

Afyonkarahisar is rich in historical and cultural sources. There are rock settlements as historical ruins, rock monuments, churches, sepulchers, fairy chimneys as natural monuments and important cultural tourism products along with its charming beauty in this area known as “Phrygian Valley” where the oldest civilizations lived. Afyon Castle, Historical Afyonkarahisar Houses, Afyonkarahisar Lodge used by mevlevi dervishes, The Great Offensive and Chief Commander National Park, Afyon Museum and other museums, festivals, expositions, symposiums, local food culture, folk dances and handicrafts constitute the other cultural wealth of the study area.

1. PURPOSE AND METHOD

The aim of this study is to determine the problems of geothermal sources in Afyonkarahisar chosen as the study field and get the authority’s attention, help the effective and productive usage of sources, point out the importance of geothermal sources on Afyonkarahisar’s tourism, and most
importantly contribute to the maintenance of geothermal sources, since the most prominent tourism product in Afyonkarahisar is thermal sources. This city is a candidate of being one of the leading destinations, even a "thermal city" in the future in terms of its thermal tourism aspect. The recent investigations in the area and especially the interests of private sector representatives coming outside the city are the significant indicators of this case. It is important both for the future of tourism in the area and for benefiting from geothermal sources in maximum rate that the potentials of the sources and their physical, ecologic, economic, and social capacities in the area should be determined, and according to these, substructure (electricity, water, communication opportunities, etc.) and superstructure (touristic facilities, activities and shopping opportunities, etc.) investment plans should be done.

The study is composed of literature survey of national and international resources, gathering information about the theme, mapping of geothermal resources in the area of study using GIS, evaluating the significance of geothermal energy in terms of tourism and making offers towards sustainability.

2. THE USAGE OF GEOTHERMAL SOURCES AND THEIR SUSTAINABILITY IN AFYONKARAHISAR

The locations of geothermal areas and their geologic structures resemble each other in Afyonkarahisar. Generally, the thermal centers are founded on alluviums as the youngest unit. Right behind these centers, there are some formations of the area belonging to Paleozoic, the oldest unit of the area. It is observed that these formations again are like a reservoir rock in all geothermal areas. Fault lines are one of the other similar features of these geothermal areas. There are fault lines near all the geothermal centers. This means that geothermal sources reach to the surface through fault lines. The general direction of these fault lines and their ranging vertically show resemblance. Moreover, if observed carefully, there are travertine depositions on and near the fault lines out of which geothermal sources come. This shows that the amount of chemicals (Ca, O and boron) making sediment and crust is high in the natural hot water (Yılmaz, 1999).

Afyonkarahisar, due to its location and geologic structure, has a rich potential in terms of geothermal sources. The geothermal water in the area has been used for health purposes since the ancient times. Today, this water is used in tourism, for health and in heating greenhouses and residences (Map 1). Geothermal sources in the study field are used in heating residences in the city center of Afyonkarahisar and in county town of Sandıklı. The geothermal heating founded in 1994 in the city center of Afyonkarahisar is being used approximately in 5000 houses; and the geothermal heating
founded in 1994 in the county town of Sandıklı is being used in approximately 4000 houses.

Afyonkarahisar is one of the important places of Turkey in terms of geothermal greenhouse cultivation (Photo 3). The hot thermal water, coming out though the fault lines due to the geologic structure of the area, is suitable for greenhouseing along with thermal spring, tourism and heating. Furthermore, having necessary hot water to heat the greenhouses in the area, which has suitable climate conditions in terms of sunshine duration and humidity rate, decreases the cost of production. This makes the greenhouse cultivation in the area more advantageous. Therefore, greenhouseing investments in the recent years have been shifting from Antalya and Mersin, in which greenhousing activities are done intensely, to the cities like Afyonkarahisar which have suitable climate conditions and are near the hot water sources (Kervankiran, 2011b).

The sustainability of geothermal sources in Afyonkarahisar is based to the rationale usage of these sources. Therefore, in order to have sustainability, first of all, the already existing sources should be analyzed very well; feasibility studies should be conducted; the sustainability of the sources should be provided; protection-usage balance should be formed; and precautions should be taken. Thermal sources are the heart of the tourism in Afyonkarahisar. Primarily, the potentials of these sources have to be determined and planning should be done accordingly. Excessive settlement should be prohibited in geothermal areas. Accumulation of garbage, domestic waste, fertilizer and chemical waste should be prevented. Moreover, the surrounding of the wells should be protected from environmental pollution. Since geothermal liquid is limited in geothermal areas, feeding-disposal balance should be kept in the usage of sources and reinjection should definitely be done. Especially in Gazlıgöl and Sandıklı-Hüdai thermal areas, there is a decrease in reservoir pressure and cooling because of uncontrolled and illegal drilling (Photo 2). Geothermal water in Tourism Centers should be planned as a whole and most importantly the water should be managed centrally.

The increase in the usage areas of geothermal sources (tourism, heating, energy, greenhousing, etc.) also increases the interest in geothermal sources. The sustainability of geothermal sources is provided when the relationship of feeding and disposal balance of the reservoirs feeding from cold meteorite water is kept; in other words, when the physical bearing capacity, one of the sustainability principles, is not exceeded. Drilling out thermal water more than needed will decrease the life of thermal sources after some time. For this reason, primarily the reservoir parameters (temperature, pressure) in geothermal sources should be observed periodically. Another protection method is protecting the reservoir from
contaminating factors leaking underground due to surface forces. Excessive settlement should not be permitted in the fault lines where geothermal sources exist, because these are the areas where surface water flows through underground in its fastest speed (Photo 2). Moreover, the accumulation of garbage, domestic waste, fertilizer and chemical waste that can cause pollution should be prevented and especially the surrounding of wells should be protected from environmental pollution. The water used in tourism facilities should be given to the municipal water system after the treating process and in this way the damage that elements such as mercury, arsenic, lead and boron having toxic features can give to the environment should be prevented.

Map 1: The Usage Areas of Geothermal Sources in Afyonkarahisar

The information on drilling in geothermal areas given in Afyon Geothermal Areas Chapter of The Inventory of Turkey’s Geothermal
Sources published in 2005 by The General Directorate of Mineral Research and Exploration shows that reinjection is only done in specific wells in Ömer-Gecek basin and this process is not done in other areas. However, it is important to indicate that reinjection process requires both technologic foundation and high cost. On the other hand, reinjection is of vital importance in terms of sustainable usage of sources for many years and also more importantly the prevention of geothermal sources, containing heavy metals, from damaging environment during the surface flow and from mixing up with ground waters after leaking underground (Kervankiran, 2011a).

Geothermal liquid is limited in the geothermal areas of Afyonkarahisar. In order to benefit from this liquid in the optimum level, benefiting from the heat of the rocks and giving back the liquid drilled out from the reservoirs in the same amounts is crucial for sustainable geothermal development. The common features of Ömer-Gecek and Heybeli thermal areas are that they do not have deep wells and the reservoirs cannot be predicted. Instead of drilling many wells, drilling deeper wells that 2 or 3 reservoirs can use will be more beneficial. Decrease and cooling have started to occur in the reservoir pressure because of uncontrolled drilling in Gazlıgöl area. Therefore, instead of drilling new wells in the area, new areas should be searched such as Bozüyük, Ablak, Akören. Instead of individual projects carried out by different institutions at different times, by determining parameters such as the geologic and geothermal characteristics and potential of the area and by carrying out a geothermal organization centrally with a project supported by institutions like Afyon Kocatepe University, State Hydraulic Works, General Directorate of Mineral Research and Exploration and the Bank of Provinces is quite significant for sustainable geothermal in Afyonkarahisar (Türker et al., 2008).

The sustainability of geothermal sources is aimed with the act of 13 June 2007 and the low no 5686 “The Low of Geothermal Sources and Natural Mineral Waters”. This low indicates that in order to drill geothermal wells, produce, manage and watch reservoirs necessary physical and chemical measurements should be done and the results of these measurement tests should be presented to Special Provincial Directorate. However, in the study field, some illegal and uncontrolled wells without these necessary measurements were observed in some thermal areas (Especially Gazlıgöl thermal area) even after this date.

It is possible that there are other areas with thermal waters other than Ömer-Gecek, Gazlıgöl, Hüdai and Heybeli geothermal sources. In respect to this, İncehisar and Susuz areas were drilled and the results are positive. After more technologic and detailed drilling in the future the usage of thermal waters will be provided in this area. In addition, by opening alternative
thermal areas will decrease the intensity in the other thermal centers and this will protect the thermal waters in these areas.

3. THE IMPORTANCE OF GEOTHERMAL SOURCES IN AFYONKARAHISAR IN TERMS OF TOURISM

The geographic location, geologic, geomorphologic and climatic characteristics of Afyonkarahisar are very effective in the formation of current tourism attractions. The abundance of thermal sources as the most important tourism fact of the city is the result of geologic structure of the area. The geologic structure of the area and the fault lines appeared after tectonic movements have great effect on the geothermal sources in Afyonkarahisar and its surrounding and on the tourism activities based on these sources. The existence of Thermal Tourism Centers on and near the fault lines ranging N-S and NW-SE on the area is the proof of this situation (Map 1). There is a close relationship between fault lines and thermal spring areas underlying the tourism activities and Thermal Tourism Centers in Afyonkarahisar (Kervankiran, 2011a).

Hot water sources known since ancient times have been serving to people from many civilizations as healing water and thermal spring for centuries. Gazlğöl and Hudai thermal springs, the oldest thermal sources in Afyonkarahisar, have been the places where people have been looking for cures since Phrygian era. Thermal and hot spring areas were used in old medical treatments and recommended by the doctors of that period. Ancient cities (Hierapolis, Metropolis, etc.) were founded, sanctuaries (Kızıl Church, etc.) were built and settlement developed quickly in these areas. Therefore, there are ancient cities near many thermal centers.

Thermal springs, for centuries, were visited by people for hot spring treatment or bathing and now this tradition has changed according to the present conditions. Nowadays, thermal springs have started to change into rehabilitation centers (Photo 1). Besides, there are thermal springs that continue as classic public baths. According to the data revealed in 2011 by Afyonkarahisar Provincial Culture and Tourism Directorate, total bed capacity in the rest areas with Tourism Establishment License is 3.337, in the thermal facilities with Municipal License is 5.077, in the rest areas with Municipal License is 3.120 and in the rest areas with Investment Certificate is 9.385. The total bed capacity of the city will reach to 20.919 with the opening of the rest areas with Investment Certificate. Afyonkarahisar will be the most important thermal tourism centers of Turkey with this total bed capacity. Undoubtedly, the most effective factor for the development of this city is geothermal sources.

The year 2023 goals of Turkish Tourism Strategy of the Ministry of Culture and Tourism include spreading the tourism season to a whole year,
diversification of tourism products, supporting and developing tourism types determined within this framework. Health—thermal tourism and culture tourism are the most important tourism ones among alternative tourism types in the goals of 2023.

It is clearly seen that especially after 2000 in Afyonkarahisar, the amount of modern thermal facilities have started to increase. Thanks to the works of local management, number of facilities and rooms, bed capacity has increased and tourism centers were opened including supportive care units such as physiotherapy, rehabilitation, hydrotherapy, psychotherapy, exercise, dieting, and skin care under a specialist control that is quite different from classic public bath management (Photo 2). The facilities in this area, which have been a center of attraction for thermal tourism investors in recent years, offer opportunities for both vacationing and alternative treatment for illnesses. In the new facilities, in addition to classic Turkish bath and sauna, swimming pools, mud and steam baths, massage units, treatment pools, physiotherapy rooms aim to give the best service to their visitors.

In Afyonkarahisar, the following four geothermal areas have been announced as “Thermal Tourism Centers” by The Ministry of Culture and Tourism (Map 1).

1. Gazlıgöl,
2. Sandıklı-Hüdai,
3. Heybeli (Kızılkılı Church),
4. Ömer – Gecek.

In Turkey’s Tourism Strategy, for the development of substructures and superstructures of thermal tourism, in order to encourage private sector, public domains and thermal water appropriations and for thermal projects feasibility studies have to be done by specialist corporations and people; thermal facilities should be planned as a complex; green areas around the hotels and treatment centers, running and tour tracks, entertainment venues should be arranged; and hotel + treatment center + treatment park integration should be included in the construction plans (Ministry of Culture and Tourism, 2008). The biggest disadvantage of thermal tourism areas in the inlands of Turkey is that these areas lack green area opportunities. The visitors coming to the hotels for health purposes generally have to stay in the hotels for a long time. Previously, the visitors using the hotel’s swimming pool, bath and treatment units used to get bored after a few days. In order to entertain the visitors coming to the hotel for these purposes, enhancing the product range and integrating different tourism activities to thermal tourism can help solving this problem.
Consequently, in order for thermal tourism centers to maintain their activities and their development in the global competition environment, they should develop strategies and policies concerning the components of sources in tourism centers, the products available of assembling to these sources, and the long and effective usage of these sources. While planning these strategies and policies, it should be noted that local people, public and private sector should work in harmony, the time-varying demands of visitors should be satisfied, customers should be pleased, the quality of service should be increased, and the workers in the sector should be educated. Moreover, the policies should be compatible with sustainable tourism principles. The strategies discordant to these principles may give transient and misleading results.

4. RESULTS

Geothermal sources contribute significantly to the humane and economic structures of Afyonkarahisar. The increase in the investments on tourism based on geothermal sources is important for the future of Afyonkarahisar, especially in order for the city’s economic development, decrease in unemployment and emigration, and rural progress. The increase in the usage area of geothermal sources (tourism, heating, green-housing, etc.) causes an increase in the problems related to geothermal sources. Drilling thermal sources in an uncontrolled way and without taking feeding-disposal balance into consideration decreases the life of thermal sources after a period. Therefore, it is of vital importance for the maintenance of sources that the potentials of thermal areas should be determined, the feeding-disposal balance of reservoirs should be maintained, and the parameters (temperature, pressure) of hot water sources drilled out of the surface should be observed periodically. This is because the tourism investments on this area depend on the existence of thermal waters. In Thermal Tourism Centers when investments are made without determining the capacity of areas and when geothermal reservoirs are not observed periodically, there can be some problems in tourism centers in the future. Scientific, technical and modern procedures should be followed while consuming hot water sources in order to prevent these problems.

Hot water in four thermal tourism centers in the field of this study is drilled out from many wells and each company uses its own drilled water. This causes disorder and lack of inspection on a large scale in the basin. The drilled thermal water is used as if it will never run short and the filling-disposal balance is upset. In the same basin, the existence of facilities with fewer people and excessive hot water consumption near the qualified facilities with more people and low hot water consumption jeopardizes the future of these qualified facilities. The control of the water in the basin becomes more difficult because of illegal wells and drilling hot water with
the permission for cold water drill. Moreover, in the same basin drilling a lot of wells causes the basin to be riddled. Especially in Gazlıgöl Thermal Center, drilling illegal wells increasingly damages the reservoir in the area, and hot water that was drilled from 80-100 meters depth has to be now drilled from 800-900 meters depth. Since drilling so many wells causes drop in the reservoir pressure, this upsets the balance of the basin. Instead, hot water should be distributed from a single center as it is done in the thermal tourism centers in Beppu-Japan, Baden Baden and Bad Füssing-Germany, Lucca-Italy, Beau Nash-England, Baden- Austria. It is necessary for the maintenance of thermal sources that regulations should be done in order to distribute water from a single center in all tourism areas in Afyonkarahisar.

REFERENCES

The Sustainable Usage of Geothermal Sources and Their Importance in Tourism in Afyonkarahisar

PHOTOGRAPHS

Photo 1: A Five-Star Thermal Hotel

Photo 2: Illegal Thermal Well and Thermal Waste Water

Photo 3: Geothermal Greenhouses