

## The Significance of Renewable Energy Resources and their Applications in Rural Tourism

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### Abstract

Rural tourism has become popular with an increasing interest in discovering new places and natural cultures that possess natural richness. It not only plays an active role in preventing immigration from the countryside but also provides opportunities for women employment in rural areas. The desire for being alone with nature and thus to move away from the difficulties and stress caused by the daily life are among the main reasons for the preference of rural tourism. Rural tourism may offer both recreational and agricultural activities to the visitors. Despite being one of the stress factors of the daily life, the use of technology and energy requirement have recently become an addiction that people cannot easily give up wherever they live. Moreover, the energy is the most needed input of almost every sector including tourism. By producing renewable energy resources instead of convective resources in rural tourism, it may be possible to reduce operating costs considerably and minimize environmental problems caused by convective energies. In addition, the use of integrated energy production or alternative energy applications in a rural tourism operation is also instructional for domestic and foreign tourists. The guests have the chance to witness sustainable energy sources through living and observing, as they use them in their daily life. Thus, a widespread impact on the use of alternative energy sources is ensured. It is of paramount significance to choose the most appropriate alternative energy source or sources that will not harm the tourism establishment. It is important to consider the following factors in deciding the energy source to be used; the geographical location of the rural tourism establishment, natural richness, sunshine days, number of windy days, the structure and location of rivers, waterfalls and lakes and proximity to geothermal resources. This research aims to explain the integration and applications of solar energy, wind energy, heat pump, geothermal energy, hydraulic energy, biomass, biogas and biodiesel, which have high use potential in rural tourism areas.

**Keywords:** Biomass, biogas, biodiesel, solar energy, hydro energy, geothermal energy, wind energy

### INTRODUCTION

The competition between cities, regions and countries is intensifying because of the increasing growth of tourism [1]. The aim of the tourism is to emphasize the availability of specific activities in the tourism [2] in order to predict an affect the behavior of tourists [3,4].

Rural tourism is identified as a means to improve the local development by means of the protection of the environment, natural resources and cultural heritage [5,6,7,8,9,10,11]. It consists of several tourism branches such as agricultural tourism [12], cultural tourism [13], social tourism [14], natural tourism [15], gastronomic tourism [16], medical tourism [17] and nature or extreme sports tourism [18].

In rural placements, small tourism companies play an important role in promoting rural development [19,20]. Many companies tend to use product and services produced in the destination where they manage, and thus contribute to a higher income multiplier effect thereat [21,22]. Rural tourism is an important factor for individuals who seek economic diversification or a economic diversification or a supplementary source of income in areas in which traditional rural industries, such as agriculture, fishing, timber and mining, are in decline. Thus, natural resources remain attractive to tourists [23,24,25]. Also, rural tourism provides opportunities for individuals who live in rural areas to develop a relationship with rural destinations [14]. Rural tourism firms are mostly small and generally belong to a family, showcasing local agricultural products and cultural activities [26,27,28]. As rural tourism creates services and

new job opportunities, and facilities foreign sources of revenue, it improves local economic growth [29].

Cooperation is highly important for rural tourism because it plays a central role for the local communities who are willing to develop tourism [30]. Several researchers have highlighted the importance of cooperation of small entrepreneurs in rural areas [4,31]. Also, studies have also shown that tourism companies that operate in the rural areas and which are united in clusters can foster the development of a destination [32,33]. Besides, local government involvement may play a decisive role in the process of sustainable development in a rural tourism destination [4].

Several studies showed a close relationship between tourism and climate change [34,35,36,37]. Tourism-related energy consumption is increasing, especially as being related to its greenhouse gasses and global climate change [38]. About 85% of the world's energy consumption consists of the fossil fuels world economy [39]. Also, tourism is one of the major energy-consuming sectors [40,41,42]. Transport, especially air traffic, is responsible for the majority of the energy consumption from tourism-related activities [37]. It is estimated that tourism-related global energy consumption is about 14 EJ, of which the share of transport, accommodation and activities sectors are 94%, 3.5% and 2.5%, respectively [34]. To prevent global warming and reduce greenhouse gasses, the needs of tourism-related energy may be provided from renewable sources instead of convective sources.

Renewable energy is admitted important for decreasing society's dependence on fossil-fuel energy and hereby

fighting global warming, which increasingly concerns mankind. For rural tourism to be sustainable, it is extremely important that the energy which is used in rural tourism business is supplied from renewable sources such as solar energy, wind energy, hydro energy, heat pump, geothermal energy, biomass, biogas and biodiesel [43]. Thus, both the energy cost, which is the highest expenditure item for an enterprise, will be reduced and the natural resources will be protected.

In this study, the definition of renewable energy sources, such as solar energy, wind energy, geothermal energy, heat pump, hydro energy, biomass, biogas and biodiesel, and the application possibilities in rural tourism are explained in detail.

#### **Solar energy in rural tourism**

The main source of all the energy in the world, including fossil fuels and excluding nuclear energy, is the sun. The source of solar energy is based on the principle that the hydrogen gas in the sun's core is converted to helium, known as fusion process. In order to take advantages of the sun's rays, many technologies have been developed from the past to the present. These technologies can be examined in two groups. The first one is used to produce heat energy with flat surface collectors and concave collectors, while the second one is used to produce directly electricity with solar panels.

In Turkey, flat surface solar collectors are widely used in the southern and western regions in which the sunrise time is long. The maximum water temperature that can be obtained with flat surface collectors is 100°C. Heated-water by the sun is either used as hot water or used in the room heating by passing through a heat exchanger. Also, heated-water or heated-air systems can be used with flat surface collectors for drying purpose. Flat surface collectors can be used in rural tourism enterprises is so as to meet room heating, drying and hot water needs.

When a temperature over 100°C is needed, concave collectors are utilized. Depending on the use, they can be manufactured in various shapes and sizes. The larger ones are usually used in solar power plants that generate electricity while small ones can be used as barbecues, cookers or sun-ovens in the household. These small-sized apparatus, which do not cause greenhouse gases and carbon emissions, should be used absolutely in rural tourism. In addition, the use of these devices will greatly reduce the energy costs of rural tourism facilities.

Unlike flat surface and concave collectors, solar panels are used directly in the production of electricity. So as to obtain 1 kWh of electricity, a solar panel with a size of about 7.7 square meters is needed. Solar panels can be placed on roof tops, on the wall of the building in the south, on the roofs of walkways and car parks. It is also possible to illuminate the rural tourism area at night with small solar panels mounted on electric poles. On the other hand, solar energy can also be utilized to generate electricity in rural areas where there is no electricity network.

The south of Turkey has more sunlight intensity than the north. A map of Turkey's radiation is given in Figure 1. According to Figure 1, Antalya, Karaman, Van, the South of Konya etc. are not suitable for the establishment of solar energy farming, whereas Kırklareli, Sinop, Edirne etc. are appropriate to obtain solar energy. However, Turkey is more fortunate than many other countries in terms of sunshine duration. Solar energy is widely used even in northern countries, where the sunshine duration is very

short. Therefore, using solar energy both in rural tourism and everyday life will be a rational approach.

#### **Wind energy in rural tourism**

Heat naturally flows from hot source to cold source. The world surface is not heated uniformly by the sun. Therefore, high pressure is formed in a hot region, and this high-pressure air flows into the low-pressure region of the colder environment. This natural phenomenon is called wind formation.

The wind speed reaches the maximum level at 500 m above the ground whereas the wind speed reaches the minimum level at 1000-1500 m above the ground. Wind energy cannot be used in areas where the wind speed is less than 3 m s<sup>-1</sup>. Similarly, wind speeds above 25 m s<sup>-1</sup> may damage the wings. Optimum wind speed is also 12-13 m s<sup>-1</sup>. In order to wind energy to be produced, the wind speed as well as the continuity of the wind is extremely important. Therefore, it is necessary for establish the wind facilities in advantageous regions according to the wind maps. In rural tourism, these maps need to be examined before investing in wind energy. Wind map in Turkey is given in Figure 2. According to Figure 2, Diyarbakir, Adana, the South of Tunceli, Duzce, Sakarya etc. are not suitable for the establishment of wind farm, whereas Çanakkale, Balıkesir, Tekirdag, the North of Izmir and the South of Hatay are appropriate to obtain of wind energy.

Wind turbines, windmills and wind power plants are utilized in the production of wind energy. Wind power projects are usually located in rural areas where the wind speed is not interrupted by an obstacle such as building, tower, complex, business center, skyscraper and forest [44,45]. On the other hand, the establishment of wind energy facilities in rural areas creates an opportunity for the economic development and modernization of rural areas [46]. Along with that, some of these areas are simultaneously attractive for rural tourism [47,48,49]. Therefore, windmills and small powerful wind turbines are more widely utilized in rural tourism.

A wind turbine generally consists of an impeller which has wings, a transmission mechanism, an automatic directing system, a braking system and a tower. As the strength of the wind turbine increases, the impeller diameter and tower length increase.

In rural tourism, wind energy can be used to extract water from the well and generate electricity. On the other hand, it can also be utilized to generate electricity in rural tourism areas where there is no electricity network.

#### **Hydroelectric energy in rural tourism**

Hydropower is the electricity generated using the energy of moving water. Humankind has been taking advantage of this energy for centuries. Ancient people built turbines, which are wheels turned by flowing water. These ancient turbines were not utilized for electricity, but they were used to grind wheat into flour. Here the basic principle is: a water wheel, which is placed in a river, picks up flowing water in buckets located around the wheel, and this motion stimulates the mechanism. Thus, the kinetic energy of the flowing river is converted into mechanical energy [50].

The initial hydroelectric power plant was set up at Niagara Falls. Even, street lamps in the city of Niagara Falls were illuminated by hydropower. Hydroelectric power provides nearly twenty percent of the world's electricity. Today, hydropower is the cheapest way to produce electricity. The water needed for hydro energy is a clean fuel source that

is renewable by snow and rainfall.

Irrespective of size and capacity, hydroelectric power plants which consist of dams, watermills, and water turbines, are usually installed in rural areas.

To use energy from flowing water, the water must be controlled. A large reservoir is created, usually by damming a river to create an artificial lake, or reservoir. These reservoirs and artificial lakes may offer recreational tourism opportunities, such as swimming, sailing and boating for rural tourism. Even around these dam lakes and water reservoirs, there are natural jungle areas suitable for rural tourism. However, damming rivers may destroy wildlife, other natural resources and cultural heritage.

Watermills, which are common in rural areas, provide another source of hydroelectric energy. They have large wheels usually located on the banks of moderately flowing rivers to generate energy that powers such diverse activities as grinding grain, cutting lumber, or creating heat to create steel.

Electricity or mechanical energy can be obtained by using Pelton turbines in places such as waterfalls at high altitudes in rural tourism areas. The Ossberger turbines are suitable for use in stream and river. Such turbines are used to generate electricity or mechanical energy in stream or rivers where the width is narrowed. To produce electricity or mechanical energy, both types of turbines are suitable for use in rural tourism.

#### **Geothermal energy in rural tourism**

Geothermal energy, which is clean and sustainable, is the Earth's own heat. Geothermal energy reaches the Earth via a wide variety of formations such as hot water, steam, warm water, hot rock, extremely high temperatures molten rock called magma etc.

Many technologies have been developed to take advantage of geothermal energy from the past to the present. These technologies are divided into three groups as generating electricity called geothermal electricity production, producing heat from hot water called directly geothermal use, and using the shallow ground to heat and cool buildings called heat pumps.

Wells can be drilled into underground reservoirs for the generation of electricity. Some geothermal power plants use the hot water to boil a working fluid that vaporizes and then turns with a turbine, whereas others utilize the steam from a reservoir to power a turbine/generator.

Hot water and steam are used in electricity generation in rural areas while hot waters near the surface of Earth are utilized in spa tourism as a health resource or in business sectors such as aquaculture, food industry, drying of agricultural crops, growing of plants in greenhouse, pasteurizing of milk.

Almost everywhere, there is a constant temperature between 10° and 16°C in 3 meters deep of the Earth's surface. Heat pumps, which are used to take advantage of this constant temperature below the surface of the Earth, are appropriate to heat and cool rural tourism buildings. A heat pump system consists of a heat pump, an air delivery system and a heat exchanger-a system of pipes buried in the shallow ground near the building. The heat pump sends heat into the indoor air delivery system in the winter whereas it moves heat from the indoor air into the heat exchanger in the summer. During the summer, the heat removed from the indoor air can also be used to provide a free hot water.

Turkey is very rich in terms of geothermal sources.

Most of these resources are located in rural areas suitable for tourism. In the rural tourism centers located near the geothermal resources, the Earth's admirable own energy must be evaluated.

#### **Biomass in rural tourism**

Biomass is defined as a sustainable and renewable resource of energy utilized to generate electricity or heat. The materials used in biomass are generally organic wastes. As in biomass fuels, these wastes generally consist of scrap lumber, straw, paddy hulls, forest debris, cattle manure, kernels or shells of some fruit such as walnut, hazelnut, apricot, peach, peanut and pistachio etc.

So as to generate electricity or heat in rural tourism, these organic wastes can be assessed either by direct burning or by the compression of compacted bricks called pellets.

In biomass power plants, organic wastes are burned to produce steam that runs a turbine to make electricity, or that provides heat to industries and homes.

Also, these waste materials used for biomass are compressed into bricks or isolation matter in order to use in rural tourism buildings. Moreover, the thermal conductivity coefficients of these bricks and insulation materials are also very high. When compressed under high pressure and temperature, insulation materials do not burn and draw water if the inside air is completely vacuumed.

Energy production such as electricity or heating from organic wastes and the use of these wastes as building materials such as bricks and isolation matters also provide a great contribution the prevention of environmental problems. For this reason, biomass is a clean energy source that can be safely used in rural tourism.

#### **Biogas in rural tourism**

Biogas produced from renewable organic raw materials is a feasible and storable energy resource. Microbiological processes become active during the generation of biogas resulting from anaerobic fermentation of organic wastes [51,52]. Colourless and odourless biogas contains methane (50%-60%), carbon dioxide (40%-50%), nitrogen (N<sub>2</sub>; 5%), hydrogen sulphide (N<sub>2</sub>, <1%) other organic components (NMOC; 2700 ppm). It is lighter than [51,53,54,55]. Density of biogas is 0.83 and its octane number is 110. It is also a gas burning through bright blue flame [56]. The heating value of biogas ranges between 26.7 – 29.8 Mj.m<sup>-3</sup> depending on the content of methane while the heating value of natural gas is 37.3 Mj.m<sup>-3</sup> [57,58].

Organic wastes are generally composed of animal manure, agricultural wastes, food wastes, human feces and household wastes. Nevertheless, cattle manure contains methane bacteria that provide anaerobic fermentation [57, 58].

Biogas is an energy source that can be converted into electrical energy by means of a generator. Biogas can be consumed both for fuel and heating [59,60].

Biogas production wastes can be used as raw material for biomass production as well as a rich fertilizer mixture in organic matter in agriculture. Organic materials suitable for biogas production are located in rural tourism areas. The evaluation of these organic wastes as biogas is extremely important concerning environmental protection and low-cost energy production.

#### **Biodiesel in rural tourism**

Biodiesel can be used as an alternative source of diesel.

It can be produced from all types of vegetable oil, animal oil/fats, tallow and waste cooking oil. The process to convert these oils into biodiesel is called transesterification. Most of the oils used in biodiesel production are obtained from oil crops such as rapeseed, palm or soybean. Moreover, biodiesel can be efficiently produced in industries where waste oils have emerged.

Biodiesel has many environmentally beneficial properties. The primary advantage of biodiesel is to be 'carbon neutral'. This means that the fuel produces no net output of carbon in the form of carbon dioxide.

Producing oil plants, such as canola and sunflower, for biodiesel can sometimes increase the cost of production. For this reason, obtaining biodiesel from waste vegetable oil is a rational approach to reducing fuel costs.

Fuel expenditures are the most expensive expenditure item in agriculture. Similarly, in the tourism sector, fuel for transportation is one of the most expensive expenditure items. The use of biodiesel as fuel in both sectors is a rational approach.

Large amount fat-free wastes occur in biodiesel production obtained from the seeds of plants, such as sesame, canola, sunflowers, maize and black cumin etc. These fat-free wastes can also be used in biomass production. Also, they can be utilized as raw materials for biogas production. Biogas production is well suited for rural areas in which plant breeding is conducted. For this reason, such clean energy must be used in the rural tourism as well.

#### Using of integrate energy in rural tourism

Depending on the geographical location, climate and structural characteristics of the rural tourism area, one or more of the renewable energy sources can be used in together. For example, in rural tourism areas where both the wind activity is sufficient and the radiation intensity from the sun is also high, the use of these two renewable sources can be evaluated in together. Similarly, biomass, biogas and biodiesel can also be integrated. For example, biogas from biodiesel production wastes can be obtained; and then, biomass, which can be evaluated as organic fertilizer or fuel, can be also produced from biogas wastes. In addition, rural tourism areas close to geothermal resources may also be suitable for solar and wind energy. As a result, in rural tourism areas where geographical conditions and climate are appropriate, all renewable energy resources can be used simultaneously.

## CONCLUSION

Renewable energy applications can be integrated into rural tourism for the development and sustainability of rural tourism, which is one of the most popular tourism sectors of today.

Solar, wind, geothermal, hydraulic energy, biogas, biomass and biodiesel can be effectively used depending on the environmental conditions and the geographical position of the rural tourism area.

By using these energies, the energy cost, which constitutes the highest cost item for a rural tourism firm, is reduced by using these energy resources. At the same time, carbon emulsions and greenhouse gases, which are extremely dangerous in terms of global warming, are also minimized.

In addition, renewable energy sources can also be used to generate electricity in rural tourism areas where the electricity network does not exist.

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