

## **IMPROVEMENTS WITHIN THE SCOPE OF ECOLOGICAL DESIGN: DADIA ECOTOURISM AREA (GREECE) \***

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### **Abstract**

It is not right to evaluate the ecological design concept that includes past, present and future perspectives only with new building designs that comply with ecological principles. Improving existing ecological measures, improving their space comfort\energy\ efficiency is of utmost importance for optimum utilization and conservation of resources. From this point of action, Dadia one of the major ecological tourism areas of Greece is presented with suggestions for improvement and development in terms of ecological design. In this sense, ecological design and ecological tourism related assumptions are explaining and supporting the current situation of ecological tourism center in accordance with the Dadia analyzing. The use of renewable energy sources in the existing service, the transport of vehicles with high CO<sub>2</sub> emissions in the tourist area and transport problems for disabled people have been identified. A solution proposal was established within the framework of ecological design measures for these basic problems. The results of the study are specific to the field and provide an idea applicable to the ecological improvement of an existing area.

**Keywords:** *Ecological Design, Ecological Tourism, Dadia\Greece*

**Jel Codes:** J8

### **Introduction**

Ecological tourism is a travel, which protects the environment and respects the prosperity of the local people that is sensitive to natural areas. Ecological tourism has macro scale targets including environmental protection, ecological structuring, satisfaction of tourists

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and local people, the fair distribution of economic income, locality in business and recycling (Kısa Ovalı and Tachir, 2015). At the point of conservation and development of the resources of ecotourism areas, land use and infrastructure, decisions in these regions should be given by local and central administrations taking into account ecological sensitivities. The understanding that the most important task of tourism is the use of natural, cultural and historical values by preserving them must be effective in these decisions, rather than earning more income.

The best design concept to meet intellectual, operational and spatial expectations of ecotourism is ecological architecture due to its understanding of environmental systems protection, acceptance of designing human friendly settlements, goals of rational use of resources and energy. Ecological architecture can be called all of the approaches such as being able to adapt to ecological systems, aiming to use resources and renewable energy, to transmit natural resources intact to future generations, to build with respect for humanity and to be sensitive to the environment (Kısa Ovalı, 2006). Kerestecio lu has shown that ecotourism is a trend on the coast in his study of the Eco tourist tendency on the Antalya- Kemer coast (Kerestecio lu, 2005). In ecotourism areas, it is expected that environmentally sensitive and energy efficient building criteria will be taken as basis in using and planning the environment, because ecological tourism the fastest growing branch of the world's largest industry today and one of the fastest growing industries for more than 50 years (Sinclair, 2005).

Ecological tourism areas have significant touristic potentials. Ecological tourism potentials cause attraction to the area. It is expected that sustainability of the potentials will be preserved. At the point of ensuring sustainability of ecological tourism areas, there is a need for designs with ecological and energy efficient improvements that can meet today's needs. According to Miyatake, ecological improvements is defined as the reduction of resource consumption to the greatest extent, the maximization of resource reuse, the use of renewable and recyclable resources, the protection of the natural environment, the creation of a healthy and non-toxic environment and the establishment of the built environment (Miyatake, 1996) .

Ecological improvement is a component of sustainable improvement. Sustainable improvement has environmental, social, cultural, economic and institutional objectives. Environmental aims are to decrease the

environmental impact of buildings, to limit the use of energy, natural resources and unbuilt land, to support an environmentally-conscious way of dwelling. Social aims are to provide good and affordable dwellings, to facilitate social stability and integration, to raise awareness about one's own living place, to promote sustainable behavior. Cultural aims are to preserve and transmit cultural objects and historical and cultural values, to upgrade buildings and places while respecting their character. Economic aims are to prolong the use of existing resources, to maintain real estate values, to safeguard the affordability of dwellings. Institutional aims are to promote participation and involvement of the inhabitants, to provide good management and maintenance (Botta, 2005)

Dadia forests in Greece, its unique nature shaped by natural formations, is a natural home in the ecosystem chain. Dadia, with this structure, is an ecotourism area with natural environment-oriented quality, in which birdwatching and hiking are performed in our days. The area with these important potentials, there is use of motor vehicle, (TDI) fueled in the area and there is the problem of transportation for disabled people (pedestrian-track line) and the use of renewable energy resources is also lacking. Problematic of this study, the shortcomings mentioned above. The sustainability of the natural resources of the ecotourism area is of vital importance at the point of improvement and development of the area in terms of ecological design.

## **2. Methodology**

Ecological tourism is a type of tourism based on nature. In this sense, the physical and socio-cultural environmental potentials of the area determine the variety of ecotourism activity. The sustainability of the action variety is possible with environment-friendly, human-friendly environment planning and building. In the study, it has been aimed to present the proposals to improve / develop the area by examining the diversity of touristic activities in Dadia and identifying the main problems (use of fueled motor vehicle, transportations for disable people and renewable energy resources) associated with them. The current situation analysis of Dadia ecotourism area was conducted by means of on-site observation, photography and individual interviews. Information about the area and mathematical data were provided by on-site observation and interviews and were supported by photographs. The obtained information and data are used in the calculation of the

ecological improvement of the area. The theoretical layout of the study is based on ecological design concept expansion and building criteria. Within the context of environmentally sensitive energy-efficient designs, suggestions are put forward regarding the followings: the track development and pedestrian line in the area for the transportation problem of disabled people; reducing the emission of harmful gases of motor vehicle use; the lack of use of renewable energy resources. It is believed that the suggestions for ecological acceptance will contribute to the sustainability of the area.

### **3. The Conceptual Expansion of the Ecological Design**

German zoologist Ernst Haeckel defines the term "ecology" as follows: "A comprehensive scientific discipline that examines the relationship of the organism with the environment" (Frodin, 2001). "Ecology" has gained importance as a very comprehensive term in different interdisciplinary fields and it has started to be used in the meaning of "environmentally friendly". Besides qualifying the continuity of nature's ecosystem cycle, with rapid development today, the word "ecological" has become an area directly related to putting natural resource potentials into good use, conservation and sustainability of natural habitats, sustainable urban development (Özkeresteci, 2007). Within this semantic transformation, "Ecological architecture" has reached an architecture that is able to establish healthy and harmonious relations with its surroundings (Kavass, 2009). In the literature study on the topic, it has been stated in the academic publications covering architecture, urban planning and landscape architecture that "ecological architect" represents a new architectural paradigm to solve environmental problems (Mchang, 1969\Yeang, 1995\Van der Ryn and Cowans, 1996\Jones, 1998\Roaf, 2003\Yeang, 2012).

Ecological architecture can be defined as all of the following approaches: Addressing the environment as a whole with its biological, cultural and psychological dimensions; adapting all the inputs and outputs of the building to the ecological system from the design of the building to its destruction; aiming to use existing materials and energy by converting them; aiming to transmit natural resources intact to future generations by prioritizing the formation of harmless waste matter to the environment; aiming to build architecture respectful to humanity (Kısa Ovalı, 2009).

The general principles of ecological architecture can be listed as follows (Tönük, 2001);

- To create healthy living and working areas that are humanistic and for family and community life,
- To ensure continuity and sustainability of the natural resources without giving harm to them,
- To create multi-disciplinary ecological studies,
- To make use of the unused building stock,
- To reduce energy and resource consumption during the construction, use and destruction of the building,
- To design buildings that produces their own energy by reducing the energy consumed by the building with the architectural organization,
- To adapt the non-consumable, clean energy sources to the structure,
- To prioritize adjacent order formations to save land and energy,
- To separate wastes and use them by converting.
- To improve the design of smart buildings with advanced technology content.

Ecological design, shaped by ecological assumptions, is an important tool in transition of the above-mentioned principles to the application level. Ecological design is a process, in environmental-climatic-cultural data are taken into consideration, that includes the concept, design, planning, implementation, construction sites, construction, use, demolition, sanitation and renovation phases (Tönük, 2001). Within this scope, ecological design is evaluated in three basic perspectives (Figure 1);

1. Re-evaluation of old buildings
2. Environmentally sensitive-energy efficient designs
3. Smart buildings that use technology

Due to the limitations, re-evaluations of the unused old building smart buildings that use technology are not mentioned in the study. Within the scope of environmentally sensitive-energy efficient designs, the methods to be followed in transferring design criteria based on ecological principles to planning are put forward. In the study, design criteria based

on ecological principles are evaluated for environmentally sensitive energy-efficient designs.

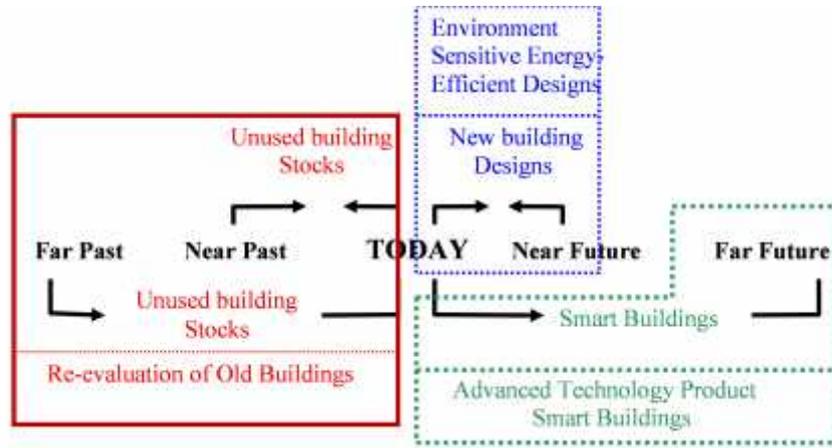


Figure 1. Ecological design within the scope of processes (Kısa Ovalı, 2009)

### 3.1. Environment sensitive energy-efficient designs

Environment sensitive energy-efficient building design includes the location of building shaped by physical environment data such as topography, climate, environment and culture and within the scope of human biology and psychology; building form, building envelope, space organization, materials selection and the use of non-consumable clean energy sources. Environmental sensitive energy-efficient criteria for ecological design has been evaluated by Kısa Ovalı (2006) under three main titles; topography and green texture, energy conservation and within the scope of suitability to the criteria regarding the use of clean energy sources (Table 1). Table 2 shows the semantic relationship between the basic approaches of ecological design and the criteria.

"Environment" has become the main decision criterion planning and practices done in this direction. In overcoming environmental problems, it is necessary to implement the designs and applications on which the ecological principles are based. The main points to be considered in the application of ecological principles are as follows (Tönük, 2001); environmental and energy issues should be used rationally in the implementation of the design, energy and renewable energy sources should be addressed to be used at min. level, natural environmental systems should be used rationally, to minimize pollution of soil and water basins (environment) caused by harmful wastes, to maintain the

continuity of plant and animal potentials in the region by protecting them, not to damage the natural environment as much as possible during the implementation of the design.

Using resources sparingly without consuming and contaminating is the basic condition of ecological design. In this sense, ecotourism, which has developed against environmental problems in global scale, is regarded as a small-scale tourism type for protecting the resources that make up the ecological system and the balances between them, aiming at making usage-related interactions between nature-human-environment and tourism activities useful, working to keep kinetic effects at minimum level, supporting economic development moderately, local entrepreneur-oriented, sensitive to the environment and the cultural-social structure, open to gradual development in the long run (Kısa Ovalı, 2006). At this point, ecological improvement criteria for ecotourism areas must be built up in all dimensions of sustainability.

Table 1.Environmentally Sensitive Energy-Efficient Design Criteria  
(Kısa Ovalı, 2006)

<b>1. Criteria For Suitability To The Topography And Landscape</b>	
<b><u>1.1. Suitability to the Topography</u></b> -To make design suitable to the existing topographic and climatic conditions -To avoid excavation or filling that will disrupt the land structure -To act rationally about the location selection in ecologically sensitive areas	<b><u>1.2. Protection of the Landscape</u></b> -Building less and increasing the number of green areas by making use of the unused building -To build at least 2 floors instead of single-story building settlements
<b>2. Criteria Related To Energy Protection (Passive Methods)</b>	
<b><u>2.1. Direction Determination of the Building</u></b> -To keep the heat and light gain from the sun at the highest in winter and lowest in summer(east-west axis settlement) -To benefit from the dominant wind effect for natural ventilation (cooling effect)	<b><u>2.4. Space Between Buildings</u></b> -To position the buildings in such a way that they don't block each other's sunshine and wind -To do the necessary isolation on the surfaces depending on the shading times, shading depth and wind effect of the buildings stay in shade,

<p><b><u>2.2. Building Form</u></b></p> <ul style="list-style-type: none"> <li>-To use lower curvature geometries compared to heat loss ratio cubic geometry</li> <li>-To reduce the surface area and the cooling area of the external surfaces in parallel with and lose less heat by increasing the building volume</li> <li>-To adjoining-build in order to reduce heat losses.</li> <li>-To design transparent surfaces on south facades, winter garden, trombe wall or an additional building with glass for heat gain</li> </ul>	<p><b><u>2.5.Space Organization</u></b></p> <ul style="list-style-type: none"> <li>-To place areas with high demand of heat as located north-south, oriented south and west,</li> <li>-To direct spaces with low heat requirement to North,</li> <li>-To overlap spaces with close or same heat requirement</li> <li>-To design spaces where solid waste separation can be done</li> </ul>
<p><b><u>2.3. Building Envelope</u></b></p> <ul style="list-style-type: none"> <li>-To focus on the transparent formation on the south facades of the buildings, solid formations on the northern facades,</li> <li>-To limit the surface area of cavities to be opened in building envelope to 40%,</li> <li>-To design areas for chimney or areas that will perform as chimney which will allow the dirty air in the building to be removed by creating natural ventilation,</li> <li>-Green roof using the soil layer as insulation material ( storing indoor temperature in cold, creating a cooling effect in hot climates)</li> </ul>	<p><b><u>2.6. Material Selection And Plumbing</u></b></p> <ul style="list-style-type: none"> <li>-To choose ecological materials produced with less energy that have durability, low cost and low harmful chemical content, more recyclable qualities, will give the least environmental damage to the system, have the quality of decomposing in nature, do not create adverse effects on user health.</li> <li>-Designing spaces to collect and store water flowing from the roof (cisterns)</li> <li>-To arrange installations that will allow the separation of solid and liquid wastes</li> </ul>
<p><b>3. Criteria Related To The Use Of Radiations (Active Method)</b></p>	
<p><b><u>3.1. Solar Collectors</u></b></p> <ul style="list-style-type: none"> <li>-It should be considered as a building component (to avoid visual pollution),</li> <li>-It meets the hot water requirement of the building</li> <li>-Low initial investment cost provides widespread use.</li> </ul>	<p><b><u>3.2. Photovoltaic (PV)</u></b></p> <ul style="list-style-type: none"> <li>-It should be considered as a building component (to avoid visual pollution),</li> <li>- The initial investment cost is expensive but it meets the electricity requirement.</li> <li>- t provides a variety of usage on the roof or as a horizontal-vertical surface.</li> </ul>

Table 2. Relationship Between Eco-Design Basic Approaches and Criteria

Basic Approaches of Ecological Design	Ecological Design Criteria
Understanding of Environmental Systems Protection	Criteria for suitability to topography and green texture
Acceptance of Designing Human-Friendly Settlements	Criteria for energy preservation (passive method)
Rational Use of Resources and Energy	Criteria for use of solar energy from clean energy resources (active method)

#### 4. Dadia Ecotourism Area Current Situation Analysis

The Dadia forest, located in Evros province in the north-eastern part of Greece which is in the eastern Macedonia and Thrace region, is an important ecological field in which the natural ecosystem cycle is experienced and it has been preserved as a National Park in cooperation with INCN\WWF since 1980. The total protected area of the Dadia forests is 42,460 hectares. All uses are prohibited on 7.290 hectare core area of forests and it is defined as first-class protected "Absolute Nature Reserve/Wild Area"(IUCN, 1994), (Figure 2-3)



Figure 2. The Location of Dadia Forests in Greece (Map of Greece 2016), Dadia Forest (Dadia ecotourism museum archive, 2016).

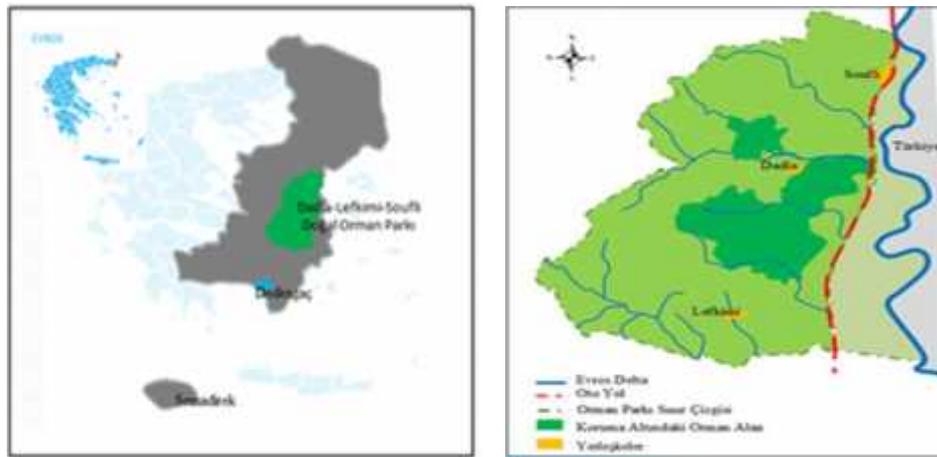


Figure 3. Dadia Forests ([Map of Dadia, 2016, Compiled by Tachir 2016](#)).

Dadia's forests are located near the eastern migration route of many bird species on the crossroads of Europe and Asia. The forests are a haven for many birds of flora and fauna of Asia and Europe. It is one of the few rarely found havens in which 36 out of 38 predatory birds in Europe are seen. Some of these predatory birds pass through the Dadia forests during migration while others spend the winter in the forest. There are about 20 kinds of nests in the forests. Dadia forests host three of four species of European vultures; Black Vulture, Egyptian Vulture and Red Vulture. They are the last colony of the black vultures and they live in the Dadia forests. The reason of the fourth species, the Bearded Vulture (Lammergeyer) for visiting these forests is that it is able to find food (carcass) easily in the forest ( Svoronou and Holden, 2005).

The composition of the forest area is shaped by Evros, geomorphological structure, soil zone and uneven terrain structure. The ecological aspect of the region is not limited to birds of prey. In terms of diversity of flora, piny large mature forests are composed of the forest area mainly larch (*Pinus nigra*) and Turkish pine mixed with oak (*Quercus spp.*) (*Pinus brutia*) and other non-evergreen species besides maquis shrubland. The Greek Strawberry Tree (*Arbutus adrachne*) Sclerophyllous shrubs, Phillyrea (*Phillyrea latifolia*), Treeheath (*Erica arborea*) and Cretan marsh marigold (*Cistus creticus*) are found in the south-western region of the forest. The forest consists of small rivers, small areas, pastures and rocks (mostra). With the unique ecosystem cycle, it has been seen that the forest contains 219 bird species, 40 different species of reptiles and frogs and 48 mammal species (Skartsi and Poirazidis, 2002).

Up to today, 360-400 plant species have been recorded in the protected area. The flower species "Minuartia greuteriana" and "Onosma" kittanae endemic are the two species among them and they are seen in this area. In addition to this, there are three rare species "Cephalanthera epipactoides", "Salix xanthicolakai" and "Zygophyllum album" in this forest area. 25 orchid species and "Eriolobus trilobatus", a very rare type of orchid, are seen in this area. 29 varieties of wild apple tree species are under protection (The Dadia-Lefkimi-Soufli Forest National Park , 2017).

#### **4.1. Dadia Ecotourism Center**

In Dadia, an office of the World Wildlife Fund (WWF) was established for the preservation of the field in 1980. The foundation, aiming to ensure the sustainability and economic prosperity of the Dadia region, firstly decided to build Dadia ecotourism center, which would be a focus point for visitors, in Dadia area and the center was completed in 1988. Dadia ecotourism center consists of the Information Building, Accommodation Unit, Birdwatching Tower and Pedestrian Tracks (Figure 4).



Figure 4. Information Center, Accommodation Unit and Birdwatching Tower Locations (The Dadia Forest National Park, 2016).

**Ecologic Information Center** is at the entrance of the area. On site-observation it is seen that, the building is a two-story reinforced concrete structure with gallery consisting of museum, a cinema hall for publicity purposes and souvenirs for income purposes for visitors to be able to get information about the area (Figure 5).



Figure 5.Dadia Ecologic Tourism Center (Tachir, 2016)

**Ecologic Tourism Hotel** is a separate building beside the ecological information center. The interview with the managing director of the ecological tourism hotel inform that an accommodation building has cafeteria and 20 rooms with 60 person's capacity (Georgitsi, 2016). The single-story reinforced concrete structure was completed in 1990 (Figure 6).

**The Birdwatching Tower** was established in 1994 as part of ecotourism activities. In situ-observation it is seen that, it is a single-story wooden structure with pent roof which is 3.5 km from the information center. A trip to the Bird Observatory is carried out by minibuses with the capacity of 14 people which leave from the Centrum every 20 minutes. It is possible to observe vultures from predatory birds from the bird observatory. The observatory is reached by a 5 min walk. Tourists are firstly informed about the vultures at the observatory, binoculars are provided for their observations (Figure 7).



Figure 6.Dadia Ecologic Tourism Hotel (Tachir, 2016)



Figure 7. Bird Observatory (Tachir, 2016)

Pedestrian Track Lines; In Dadia Center, there are four hiking lines with different difficulties and lengths (Table 3).

Table 3. Four Different Hiking Track Lines (The Dadia Forest Park, 2016)

Trail Lines	Specifications
 	<p>This is the track with little difficulty and slightly inclined paths. It starts from the information center and ends at the bird observatory. The track is 3,5 km long and takes approximately 60 minutes to complete. On this track it is possible to find the unique vegetation of the forest and the traces of large and small mammals and to see black stork, short-toed eagle, hawks, falcons and other birds flying over the rocks by walking on old horse cart roads through the forest.</p>
	<p>This track returns from the bird observatory to the information center. The track is 2.5 km, slightly sloping and takes 45 minutes. On the downhill track, the old horse cart road, which goes down from the fields to the lira stream, is followed. On this road, it is possible to see the wild flowers growing in the forest. Also the small birds around, Crossbill, Thrush and Woodpecker, can be heard.</p>

	<p>Starting from the information center, the track ends at the top of the Gibrena Mountain at 520 m. It's a track that climbs upwards. This track, which takes 150 minutes, is 4.7 km. On this track, black pines and acorn trees can be seen. Before reaching Gibrena hill, colorful flowers in open meadows can be seen and a panoramic view of Byzantine remains and Dadia's forehead can be viewed when reached the top.</p>
	<p>It is the return track from the Gibrene mountain; it is 4.5 km. and takes about 90 min. The track passes through the forest during hiking and Oak, Hornbeam, Kumara, Matey, Heather as well as many other bushes and wild flowers can be seen. Following the Diavlorema stream, it reaches the cultivated areas.</p>

#### 4.2. Essential Problems of the Ecotourism Center

Ecological building designs are expected in ecotourism areas. Ecological building has the objectives of understanding of environmental systems protection, acceptance of designing human-friendly settlements, rational use of energy and resources. Although the Dadia ecotourism center was completed in 1995, it has been detected that the ecological design criteria were partially used in the area and also the followings have been determined;

- There is use of motor vehicle, (TDI) fueled in the area,
- and There is the problem of transportation for disabled people (pedestrian-track line) and
- The use of renewable energy resources is also lacking.

**Motor vehicle is used in the area;** Motor vehicle is used to reach from Dadia's ecotourism information center to the birdwatching tower, which is 3.5 km away. The interview with the staff of the ecological tourism center inform that during the day, diesel minibuses make 12-14 tours. Motor vehicles release harmful gasses such as CO<sub>2</sub>, CO and HC to the environment. One of these, CO<sub>2</sub> gas, causes global environmental problems such as global warming, perforation of the ozone layer, climate changes. One of these motor vehicles, a minibus traveling about 40 km / h, releases 181,482 gr \ km CO<sub>2</sub> in half an hour (Table 4).

Table 4. Diesel and Gasoline Motor Vehicles' Release of CO<sub>2</sub> to the Environment at 40km\h (Fiat Ducato van motor – Volkswagen, 2017)

	Avg. Chemical Formula	Density (kg/L)	Mixed Avg. Consumption (L/100)	Avg. Speed (km/h)	Time (h)	Travelled Distance (km)	Consumed Fuel (L)	Total CO <sub>2</sub> Release (gr)	CO <sub>2</sub> Release (gr/km)	Total C Release (gr)
Diesel	C <sub>14</sub> H <sub>30</sub>	0.832	7.0	40	0.500	20.000	1.400	3629,63	181.482	989.801
Petrol	C <sub>9</sub> H <sub>20</sub>	0.755	10.0	40	0.500	20.000	2.000	4705,31	235.266	1283,13

This rate for every round of Dadia ecotourism area;

$$181.482 \text{ gr}\backslash\text{km} \times 3,5 \text{ km} = \underline{635.187 \text{ gr}\backslash\text{km}}$$

If it is thought that an average of 13 tours are made per day;

$$635.187 \text{ gr}\backslash\text{km} \times 13 \text{ tour} = \underline{8257.431 \text{ gr}\backslash\text{km}}$$

These values create a major environmental pollution for Dadia area. In the area, we recommend the use of electric vehicles (EVs) instead of motor vehicles to be compatible with ecological acceptance. It is because the use of electric vehicles has the following advantages (U urlu and Öztuna, 2015);

- The energy consumption costs of electric vehicles are very low.
- Their spare parts, repairing and service rates are very low.
- They do not emit sound and vibration to the surroundings.
- They do not release harmful gases into the atmosphere.

**The lack of use of renewable energy resources**; it has been seen that resources and renewable energy are not used efficiently in Dadia area. The potential solar energy is never used in the area. The areas own energy can be provided from solar energy using Photovoltaic Panels up or near of ecological tourism center building. The interview with the staff of the ecological tourism center inform that the energy consumption of the area in July is 15.4kW (Tsiantikodis, 2016). Photovoltaic panel energy efficiency changes according to climate characteristics and design inclination. In general, it is 624m<sup>2</sup> for 100.0 kW energy capacities (Table5).

Table 5. Photovoltaic Panel Features( Duffie and Beckman, 2013)

Type		Momo-Si
Power Capacity	kW	0.26
Productivity	%	16.0%
Nominal working cell temperature	°C	45
Temperature Coefficient	%\ °C	0.40%
Unit cell collector area	m <sup>2</sup>	1.623
Total solar collector area	m <sup>2</sup>	624
Various losses	%	10.0%
<b>Inverter</b>		
Productivity	5	85.0%
Capacity	kW	100.0
Various losses	%	10.0%

This rate for the Dadia ecological information center;

For summer months, an average of 100.0 kW\ 624 m<sup>2</sup> x 15.4 kW =96.096 m<sup>2</sup> area is needed.

In winter, 200-250 m<sup>2</sup> of space is required for general energy consumption, given that the amount of energy required is doubled in winter months. It is possible that the information center, on the area 6000 m<sup>2</sup>, can provide its own energy using photovoltaic panels sloped on the roof or laid horizontally side by side. In addition to this, it is foreseen that a station in front of the information center where the proposed electric vehicles can be charged can help reaching the solar energy based solution.

**The problem of transportation for disabled people (pedestrian trail lines)** shows that the acceptance of human-friendly universal design is partially applied in Dadia area. The ramp in reaching the bird watching tower has been partially applied and no ramp has been considered on returning pedestrian track (Figure 9).It is seen that ramps and resting points for the disabled have not been considered in yellow, orange, red and blue tracks which are the pedestrian track lines. Birdwatching pedestrian tracks and other pedestrian track lines are on the slope that the disabled people can easily reach (10%), have safety bars and are made of pliable, light-structured and unfounded constructions.



Figure 9. The Ramp Problem for Disabled People (Tachir, 2016)

## 5. Result and Suggestions

In the 21st century, the need for ecological and energy efficient design of building improvement applications with the analysis of sustainability has arisen. It is aimed to use the environmentally friendly, human-focused and energy efficient, the necessary energy generation separately from the building integrated to the building, by improving the original identity of the building and its architectural characteristics without any harm to it, by providing the comfort conditions required by the time instead of destruction of existing buildings with the ecological improvement giving this necessity.

In the overall evaluation of improving ecological design of ecotourism area Dadia, it has been seen that three basic factors were required for the sustainability of the area by preserving it (Table 6);

- In Dadia ecotourism area, within the framework of environmental systems protection, electric vehicles, which operates by the method of converting the energy stored in the batteries into the movement energy by means of an electric motor, must be used due to their zero emission, quiet operation and low energy cost.
- The pedestrian and track lines in the Dadia area must be redesigned and built within the frame of acceptance of human-friendly designing areas in accordance with universal design criteria considering the transportation of disabled people.
- The renewable energy sources should be utilized to the maximum extent possible by meeting the energy need of the ecologic tourism information center by photovoltaic panels.

Table 6.The Problems of Dadia Area and Suggestions within the Frame of Ecologic Design Criteria

<b>Ecologic Design Concept Criteria</b>	<b>Dadia Ecologic Tourism Area Problems</b>	<b>Suggestions Made For Dadia Ecologic Tourism Area Problems</b>
Understanding of environmental systems protection	Use of motor vehicle in the area	Use of electric vehicle
Acceptance of Designing Human-Friendly Settlements	The transportation problem for disabled people (Pedestrian and trail line)	Design of pedestrian and track lines with the ramp for disable people
Rational use of resources and energy	Lack of use of renewable resources	Photovoltaic should be used for the energy requirement of the ecotourism center.

It is expected that the ecological design criteria, including all of the objectives of understanding of environmental systems protection, designing human-friendly settlements, rational use of resources and energy, are applied in the use and planning of the ecotourism area. It is because the sustainability of the ecotourism areas and its place in the future will be revealed by planning and designs that reflect the environmental and renewable energy resource use.

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