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Analysis and assessment of tourism comfort using The thermal discomfort index (THI) – case study of El Kala Municipality (North-East of Algeria)

Derradji S. E., Guessoum D. E., Zennir R. **Analiza i ocena komfortu turystycznego za pomocą indeksu dyskomfortu termicznego (Thermal Discomfort Index THI) – na przykładzie gminy El Kala (północno-wschodnia Algieria)**. Każdego dnia człowiek wykonuje wiele czynności, ale od czasu do czasu musi zregenerować swoją wewnętrzną energię. Musi więc odpocząć. W tym przypadku najlepszą aktywnością jest turystyka, ale klimat też odgrywa ważną rolę, kontrolując swój sukces lub porażkę, zmieniając swój charakter i specyfikę z regionu do człowieka. Klimat decyduje zatem o zadowoleniu turysty, a tym samym o poziomie komfortu turystycznego. Celem badania jest wykazanie związku między turystyką a klimatem w gminie El Kala (północno-wschodnia Algieria), a w szczególności wpływu klimatu na komfort turystyczny. Wyniki pokazały, że komfort turystyczny El Kala jest na poziomie od dobrego do doskonałego i zmienia się co miesiąc, z dodatnimi wartościami w ciągu roku, z wyjątkiem dwóch miesięcy, w których był ujemny.

Дерраджи С. Э., Гуэссоум Д. Э., Зеннир Р. **Анализ и оценка туристического комфорта с использованием индекса теплового дискомфорта (ТНІ) – на примере муниципалитета Эль-Кала (северо-восток Алжира)**. Каждый день человек занимается многими видами деятельности, но время от времени ему необходимо восстанавливать свою внутреннюю энергию. Поэтому он должен отдыхать и развлекаться. Здесь туризм является лучшим видом деятельности для этого, однако климат тоже играет важную роль, контролируя его успех или неудачу, и меняет его тип и специфику от региона к человеку. Таким образом, климат определяет удовлетворенность туриста и, следовательно, степень туристического комфорта. Цель настоящего исследования – выявить взаимосвязь между туризмом и климатом в муниципалитете Эль-Кала (северо-восток Алжира), в частности, влияние климата на комфорт туристов с использованием индекса теплового дискомфорта ТНІ. Результаты показывают, что туристический комфорт в Эль-Кала находится на уровне от хорошего до отличного, и меняется ежемесячно, с положительными значениями в течение всего года, за исключением двух месяцев, в которых он был отрицательным.

Derradji S. E., Guessoum D. E., Zennir R. **tahlil wataqyim alraahat alsiyahiat biaistikhdam muashir alainzieaj alhararii (THI) – dirasat halat baladiat alqala (shmal sharq aljazayir)**. yumaris al'iinsan kula yawm aleadid min al'anshitat, walakin min waqt lakhir yahtaj 'iilaa tajdid taqatih aldaakhiliati. lidhalik, ealayh 'an yastarih wisli nafsahu. tuetabar huna alsiyahat hi 'afdal nashat lilqiam bidhalik, fi hina, yaleab almunakh dwran mhman fiha, min khilal altahakum fi najahiha 'aw fashaliha, wataghyir naweiha wakhususiaatiha min mintaqat 'iilaa 'ukhrra. falmunakh hu aladhi yuhadid rida alsaayih wabialtaali darajat alraahat alsiyahiati. ainjazat hadhih alwaraqat albahtiat litaslit aldaw' ealaa alealaqat almawjudat bayn alsiyahat walmunakh fi

baladiat alqala (shmal sharq aljazayir), walimaerifat athar dhalik ealaa alraahat alsiyahiat, waietetamadna fi dirasatiha waqiasiha ealaa muashir alainzieaj alhararii THI. wa'azharat alnatayij fi nihayat almataf 'ana alraahat alsiyahiat bialqalat kanat fi mustawa jayid 'iilaa mumtaz, wamutaghayiratan shhryan, mae tasjil qiam mujabat tul alsanat biaistithna' shahrayn kanat fiha salbiatan.

Key words: tourism, climate, tourism comfort, thermal discomfort index, municipality of El Kala

Słowa kluczowe: turystyka, komfort turystyczny, indeks dyskomfortu termicznego THI, gmina El Kala

Ключевые слова: климат, туристический комфорт, индекс теплового дискомфорта, муниципалитет Эль-Кала

alkalimat almiftahiatu: alsiyahat, almunakh, alraahat alsiyahiat, muashir alainzieaj alhararii, baladiat alqalati

Abstract

Every day, human being exercises many activities, but from time to time, he needs to regenerate his internal energy. So, he has to rest and entertain himself. Here, tourism is the best activity to do that, however, the climate plays an important role by controlling its success or failure, and changes its type and specificities from region to author. So, climate determines the satisfaction of the tourist and thus the degree of tourism comfort. To highlight the relationship between tourism and climate in the municipality of El Kala (North-East of Algeria), in particular the effects on tourism comfort, this study has been completed, and we have relied on the THI to examine and measure that. The results eventually showed that the tourism comfort of El Kala was at a good to excellent level, and variable monthly, with positive values for the length of the year, except for two months in which it was negative.

Introduction

At present, tourism is considered to be an important part of the economic sectors. It has become a stand-alone industry on which various nations focus and look after it through its development and investment promotion, and rely heavily on it for the development of their economies and financial resources. These countries make use of all their potential and all that can contribute to the development of this important and multifaceted economic activity. Respect the global orientation of creating a sustainable and environmental economy.

This potential varies from one country to another. It competes among itself to value everything that exists in its territory, especially everything that is related to the environmental aspect and is used as an element of tourist attraction to create strong and prosperous tourism and to raise its economic profile.

Climate is one such element that affects the value and quality of tourism polarization and is part of the natural potential. It is the main controller of human behaviour and practices and even determines their nature and types. It is also often and primarily responsible for its effectiveness, as in some economic activities.

Tourism is considered to be part of these activities, as an urgent consequence of rest, recreation, self-welfare, feeling and taste of nature, and the enjoyment of residence in areas where it is unusual to live (DARWICHE, EL HAMAHMI, 1997). The climate here plays an important role in its success or failure (MUBARAK HASSAN, VARSHOSAZ, EISAKHANI, 2015), as it can be an adjunct or an impediment to tourism activity. It can increase or reduce the attraction of tourists and control their spatial destinations. It plays a significant role in the volume of financial return (as in peak or recession season) and changing the nature of its elements from one region to another also changes the type and characteristics of tourism in practice. The connection here is very strong, because it is the climate that determines the degree of tourism comfort and well-being.

To highlight this close and integrated relationship between tourism and climate, many

researchers in this field have done many studies and research to address this, depending on their different data and indicators (BESANCENOT, 1990).

One such indicator is the tourism climate index (TCI), which is used to study and analyse the potential impact of climate change on tourism, where Z. MIECZKOWSKI (1985) is the first researcher use this index in the year 1985, by exploiting the seven elements of climate to assess its impact and utility on tourists.

As a result, the application of this indicator has spread to many regions of the world, with several studies based on it, including S. Toy and S. Yilmaz to determine climate comfort in three different regions of Turkey (TOY, YILMAZ, YILMAZ, 2007) and Faraj Zada and Ahmed Abadi to assess and divide the tourism climate in Iran using this indicator (FARAJZADEH, AHMADABADI, 2010). This indicator was also used in China by FANG and YIN (2015), while BEHAYLU and TESHOME (2018) employed it in seasonal analysis using the TCI for key tourist areas in Ethiopia.

In addition to the (TCI), the Thermal Discomfort Index is one of the indicators initially used to study the relationship between climate and human comfort. First employed and used by the researcher THOM E. C (1959) to determine human comfort under certain climatic conditions, relying on two climatic elements: temperature and relative humidity, or dry temperature, wet temperature and dew point. In the same context, it was applied by Mustapha KEBICHE (1996) to study the climate and its impact on health and tourism in the region of Setif in Algeria, where the sub-continental climate prevails. C. MAFTEI and C. BUTA (2017) utilized the THI to identify thermal discomfort in the coastal zone of Black Sea, in Dobrogea Region. This indicator was also used by ADNAN HOZAA Al Bayati (1998) to learn about the effective temperature and human sense of the climate situation in Doha, Qatar, while Firas ELAS (2021) employed it to measuring physical comfort indicators in Beirut City and determining climate-friendly periods for health and tourism.

It should be noted that many scientists have conducted studies and research papers using both indicators (TCI+THI), such as the study by Ilhem MUBARAK HASSAN, K. VARSHOSAZ, N. EISAKHANI (2015), to analyse and evaluate their impact in the Iranian city of Dezful.

In this paper, we used and focused only on the thermal discomfort index to study the case of El Kala Municipality in the North-East of Algeria. This is aimed at measuring and determining the comfort and well-being of tourism in this municipality and highlighting the role of climate elements and their direct and indirect impacts on them. This work is part of a Ph.D. thesis in preparation on the reality and future of tourism in the municipality of El Kala.

Study area description

El Kala is a municipality and administrative district of El Tarf Province, located in the north-east of Algeria. It is 90 km from the city of Annaba and 16 km from the Algerian-Tunisian border.

It is bordered to the north by the Mediterranean Sea, to the south by the municipality of Ain El Assel and the municipality of Raml Souk, to the east by the municipality of Oum El Teboul, and to the west by the municipalities of El Tarf, Bouteldja and Berrihane (fig. 1). The municipality covers an area of 292 km². It is the largest area in the state of El Tarf Province.

The Mediterranean climate prevails in El Kala. It is characterized by the diversity of its topography between the Mesolithic Region and the Mountain Region (127 m to 330 m a.s.l.).

It had a population of 44000 (2018) and a population density of 136.98/km².

El Kala is a coastal and tourist municipality with excellence, renowned for its scenic scenery (photo 1), over 50% of its area is forested, it also contains important wetlands (Lake Mellah, Lake Tonga and Lake Oubeira), considered part of one of the most important Algerian national parks (PNEK) and classified internationally, this biodiversity created and led to animal diversity. It's famous for it, like a wild deer. Its

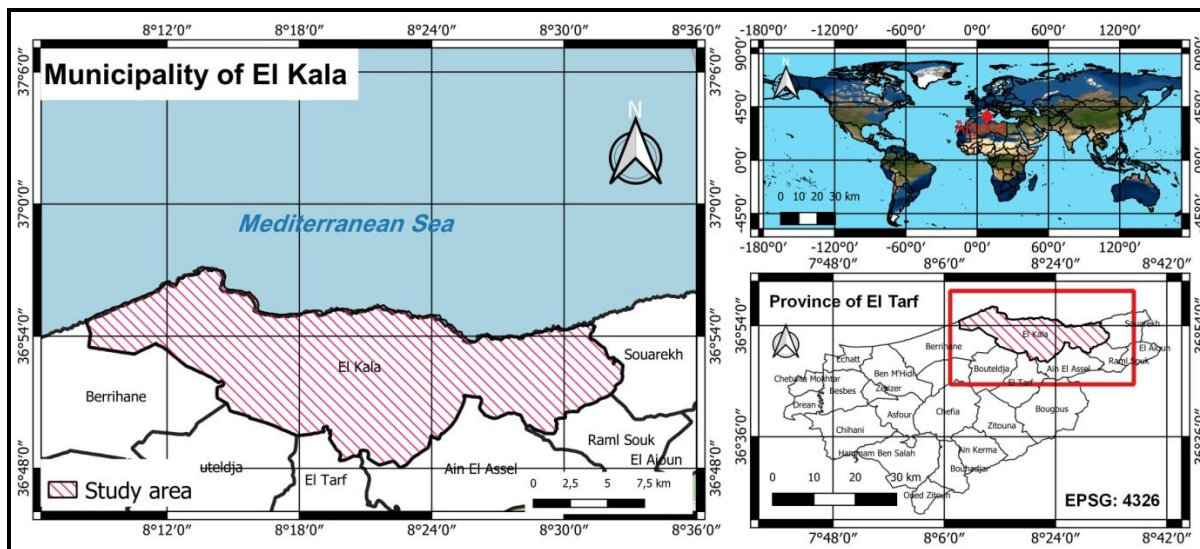


Fig. 1. Geographical situation of the municipality of El Kala (source: authors, 2021)

Rys. 1. Sytuacja geograficzna gminy El Kala (źródło: opracowanie własne, 2022)

Рис. 1. Географическая обстановка муниципалитета Эль-Кала (источник: собственная разработка, 2021)



Photo 1. The sea-front of El Kala City

Fot. 1. Nadmorska promenada miasta El Kala

Фот. 1. Набережная города Эль-Кала

coast stretches 56.7 km, marked by a large wealth of coral (it is the coral capital of Algeria).

It is an important maritime centre, along with fishing activities of all kinds and also one of Algeria's most important coastal areas.

It attracts tourists from inside and outside the country and has many natural, historical and cultural features, as well as various tourist accommodation and reception structures (DERRADJI, 2013).

Data and methodology

Data used

The data used to calculate the thermal discomfort index (THI) in this study are: maximum daily temperature, minimum daily relative humidity, average daily temperature, and average daily relative humidity.

The data of the weather stations located in El Tarf and Annaba Province have been used. In addition to FAO climate data through its database (FAO, 2019) and its CLIMWAT 2.0

programme, this provides access to data for 5000 stations worldwide, with a time frame between 1971 and 2000 (for the time period after that, we could not use it, because, it is incomplete and there are undefined and unknown values in some months and years).

Methodology

To identify, measure and analyse tourist comfort and well-being in the municipality of El Kala and the role of climate elements and their direct and indirect impacts on tourism activity, we have relied on the thermal discomfort index (THI), through the database, that we created with the four climate elements of the study area:

- Maximum daily temperature,

- Minimum daily relative humidity,
- Average daily temperature,
- Average daily relative humidity.

Thermal Discomfort Index or Temperature-Humidity index (THI), it's also called the Thom Index (FADAEE, RAMEZANI, FADAEE, 2013), which developed its equation in 1959, to determine human comfort under certain climatic conditions, based on temperature and relative humidity.

We calculated it by the following equation:

$$THI = T - (0,55 - 0,55RH)(T - 58) \dots\dots\dots(1)$$

RH: relative humidity (%)

T: air temperature (°C).

The result can be classified according to the following table 1.

Table 1. Rating categories in Temperature-Humidity Index (THI) (after: ELAS, 2021)

Tabela 1. Klasy wartości indeksu dyskomfortu termicznego THI (wg: ELAS, 2021)

Таблица 1. Пределы значений индекса теплового дискомфорта THI (по: ELAS, 2021)

THI score	Descriptive category
Less than 10	Great discomfort
10–15	Medium discomfort
15–18	Relative comfort
18–21	Complete comfort
21–24	Relative comfort (10–50% of people feel uncomfortable)
24–27	Average discomfort (100% of people feel uncomfortable at value 26)
27–29	Very discomfort
More than 29	Significant and serious stress on health

Results and discussions

After collecting, sorting and preparing the data needed to complete this study of El Kala Municipality, a database was prepared for the time period 1971–2000, from which we calculated the (THI) based on the equation mentioned earlier. The result was translated into the following tab. 2.

The application of Thom's equation on the monthly climate data of El Kala during the period between 1971–2000, shows multiple levels of climate comfort for each month, reflecting the reality of the Mediterranean coastal climate that prevails in the region, which is one of the most suitable climates for human habitation. The

months in which the climate classification was Very discomfort were July and August, with an index value of 27.8 (table 2), during this period, high temperatures are associated with extreme humidity. Relative humidity values remain high throughout the days of the year (72 to 80%).

This has also been compounded by the fact that the municipality contains wetlands (Lake Mellah, Lake Tonga and Lake Oubeira), as well as the presence of the coast.

On the other hand, the rest of the months have a comfort that is rated between complete, relative and average (Fig. 2). Through all of this, the results are very positive.

Table 2. Scores and descriptive values for THI in El Kala municipality

Tabela 2. Wyniki i opis wartości THI w gminie El Kala

Таблица 2. Результаты и описание значений THI муниципалитета Эль-Кала

Month	THI score	Descriptive category
January	14,83	Medium discomfort
February	15,33	Relative comfort
March	16,87	Relative comfort
April	18,83	Complete comfort
May	21,58	Relative comfort
June	24,54	Average discomfort
July	27,01	Very discomfort
August	27,34	Very discomfort
September	25,76	Average discomfort
October	22,70	Relative comfort
November	19,48	Complete comfort
December	15,94	Relative comfort

Source – źródło – источник: prepared by authors based on the results of the study, 2021

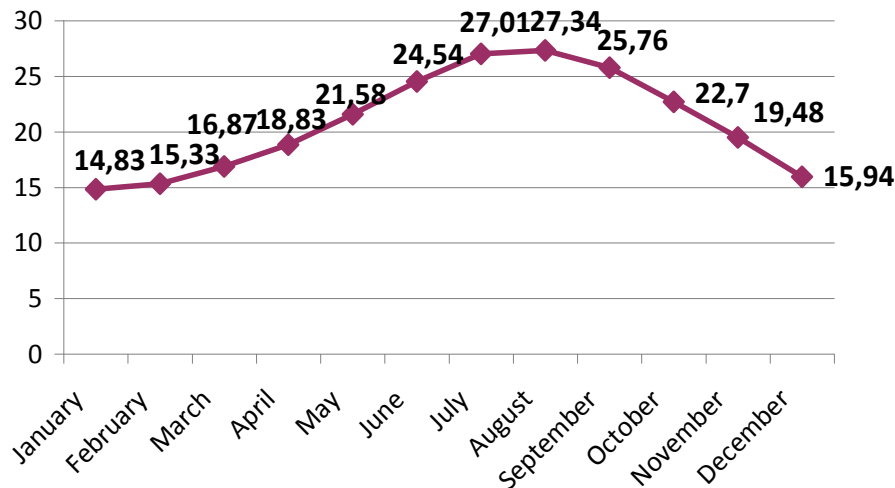


Fig. 2. Monthly changes of the Thermal discomfort index (THI) in El Kala municipality

Rys. 4. Miesięczne zmiany wartości indeksu dyskomfortu termicznego THI w gminie El Kala

Рис. 2. Изменения значений индекса теплового дискомфорта THI по месяцам муниципалитета Эль-Кала

(Source – źródło – источник: prepared by authors based on the results of the study, 2021)

It can be said that the municipality of El Kala, which has good climate characteristics, qualifies it to be at the required level (all assessments above average except July and August). The diversity of values could help attract different and diverse segments of tourists throughout the year, and could also help create different types of activities related to the tourism sector.

Conclusion

The topic addressed in this paper is tourism comfort and well-being in the municipality of El Kala. To achieve this goal, we have been used to determine and assess the level of such comfort and well-being using accepted scientific methods to systematically identify the impact of climate on tourism activities, so that they can later be used by anyone who has a distant or close relationship with the tourism sector (tourists, private and public operators...). So we used the

thermal discomfort index (THI) as a benchmark for assessing the quality of the climate and the tourism experience and proposing appropriate times for it during the year in El Kala. The results we get show that the comfort and well-being conditions are excellent and very good, they can be used as an attraction for tourists to raise the revenues of this sector in the municipality, provided that this activity is diversified according to the category polarized during the months and days of the year.

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