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Tourism in the Coastal Area Between Saida Soualha-el Konaa and Its Hinterland: Potentials, Amenities, and Environmental Challenges

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Abstract

Tourism is one of the major sectors that contributes to the added value in many countries. Certainly, "mass tourism" is the most prosperous activity worldwide, especially for underdeveloped countries, despite the great wealth, they encompass in terms of natural landscape and human heritage. However, these countries encourage mass tourism, just for the reason of creating jobs and wealth for the operators in this field. The natural landscape, the quality of services provided by the region and the degree of thermal comfort are among the most important factors that contribute to its selection as a touristic destination. However, the study of thermal comfort runs up against a dilemma, represented by the deficiency of measurements of the different climatic elements that must consider, in their distribution, the changes in the geomorphological landscape and the evolution of vegetation cover in terms of composition and distribution, as well as the degree of topographic complexity. Despite all the advantages that it can generate on the local economies of the regions El Haridba and Al Shuqaiq, tourism contributes significantly to the degradation of the coastal environment and the plain of Tibama. Based on the analysis of the natural environment components and the water and soil analysis carried out by several researchers, the main challenges, and obstructions to the successful promotion of tourism in the southwestern front of Saudi Arabia have been identified. Until today, the region El Haridba- Al Shuqaiq still suffers from a lack of sustainable a fully tourism infrastructure, as the private car is still the most used means of transportation for all trips. However, there are several ways to apply the principles that are the basis of sustainable tourism. But the rapid and continuing growth of tourism has led to enormous pressure, following the establishment of an inappropriate tourism infrastructure along the beaches rich in mangroves and coral reefs. The modeling of the atmospheric temperature, humidity, and the index of the land surface temperature (LST) of the entire southwestern coastal belt as well as its hinterland show that the climatic environment between Saida Soualha and Konaa presents favorable conditions to think of other tourist circuits of great opportunities.

Keywords: Coastal Ecosystems, Environmental Amenities, Environmental Challenges, Eco-Tourism.

Introduction

Saudi Arabia has long been identified as the world's leading destination for religious tourism. It has mobilized millions of pilgrims every year. It has been a beacon in the field of travel planning, mass reception of visitors, pioneer in the field and quality of service. It is thanks to this ancient religious function that Saudi Arabia has been able to build on its long experience in crowd control and pilgrim management and safety, especially during El Hajj and the Umrah.

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In the past, the northwestern region was a structuring element of the Saudi territory and forms a spiritual link of the Muslim world, along which the two main holy cities and places of pilgrimage (Mecca el Mukarramah and El-Medina) are linked. This area has been qualified as the focal point of the country in terms of sacred roads and religious tourism, while the rest of the country has remained for some decades away from all tourism practices and from decision-making and economic development based on tourism, despite the geoarchaeological and natural wealth that it had. Currently, the authorities have understood that the country depends too much on religious tourism and petrochemical industries, but not enough on the exploitation of other typical wealth of the country, comprised of multiple renewable sources and capable of providing high added value to the country. On the other hand, over the last few decades, Saudi Arabia has been investing in promoting tourism based on its historical heritage, culture, natural landscapes, and culinary specialties, which has increased tourism revenues to 3.02 billion euros, and the number of tourists to over 20 million visitors in 2019. In terms of absolute numbers, it occupied the thirteenth place worldwide (World data, 2023). As part of adapting to new global requirements in terms of ecotourism and sustainable tourism, the authority wanted to make the west coast a gateway to Saudi Arabia through the development of tourist areas (Al Shuqaiq, El Qahma.) and the integration of geo-archaeological sites, seaside resorts and natural parks in tourist circuits designed to gradually bring the country out of its historical oil rent by diversifying its economy and relying more on renewable natural resources. This is obviously a very ambitious and serious attempt that has been initiated to multiply the income generating activities, but it is not without environmental controversies. It should be noted that most Saudi beaches and landscapes are still in a wild state and unknown to most visitors (virgin beaches and volcanic landscapes). A long work of investigation, prospecting and classification remains to be done in this field. It seems necessary to define the tourism resources of the west coast and its hinterland for the purpose of estimating the potential uses for this region to maintain a profitable position in a changing and particularly competitive context (on a regional and global level). Other facts that are not of lesser importance are the adverse effects, largely environmental that can be caused by the tourist activity on the existing ecosystems, that have been adapted to their environment for a long time. In order to achieve a detailed analysis and usable research in terms of practice, it was considered important to highlight the contribution of remote sensing, available stationary climate measurements and analysis made by other researchers to provide operators and users with an accurate and updated database of this area with high tourism potential.

Theoretical Background and Literature Review

The present work is based on a review of scientific literature implementing new trends and recent practices in the tourism industry (Mieczkowski, 1985; Boo, 1990; Inskip, 1991; De Freitas et al, 2005 and 2003; Hénia and Alouane, 2007; Som and Al-Kassem, 2013). Many of these studies have considered the principles of sustainable tourism to optimize the holidays by prioritizing the environmental and educational dimension, yet without denying the legitimacy of satisfying entertainment needs; Morgan et al, 1995; McBoyle, 2005; Barabé, 2013). Among these studies, there are also those that highlight the potential provided by the technique of remote sensing in the field survey, especially in the estimation of thermal comfort and the delineation of recreational areas in harmony with environmental requirements (Besancenot, 1990; Gomez-Martin, 2006).

It is through the integration of spatial data in a geographic information system that some researchers have managed to make a spatial typology and patterning to estimate the tourism

potential of the coastal band, between El Haridha and Saida Soualha, yet sensitive, given what it represents for the ecosystems of mangroves and coral reefs. (Seddon, and Khoja, 2003; Som and Al-Kassem, 2013; ALMamony, 2015; Al Sliman, 2017).

These studies were undertaken to promote the development of ecotourism which can solve the problem of regional disparities. Because the investment in the tourism sector is one of the shortest and quickest paths to wealth accumulation provided that the back is not turned to the environment (Boo, 1990; Blangy, 1993). The ultimate objective of these studies is to make the tourism sector a feasible engine for economic growth based on the natural potential of each region. These natural resources were not lacking in the Tihama area and its surroundings. The contribution of this research comes to support the various tourist approaches that have been undertaken for several decades ago, but also solicit in the stakeholders and users the spirit of reconciliation with the environment with all its morphoclimatic, biological and human components in terms of heritage values. The main interest of this work is to highlight the potential, particularly, regarding the landscape and human aspects of the study area and the constraints that may hinder the tourism process.

Nearly two decades have passed since the establishment of the first coastal tourism facade south of Tihama. A time deemed to be sufficient to assess this experience from the socio-environmental point of view and raise the difficulties that may put at peril the smooth running of the program of tourism promotion that has been undertaken in Al Shuqaiq- El Qahma and El Quenfudah, even if the data are not yet available in a well-documented and archived form. Some of the impacts are measurable and others are quantifiable, but have not been seriously measured, can serve as a guide to enumerate the factors and human interventions that may put coastal ecosystems at risk, currently qualified as among the most vulnerable in the world given the ongoing global changes. Catching up with the drawbacks of the first experience is still possible because almost 90% of the southern coast of Tihama, including the Saida Soualha-Konaa coast, is still in a pristine state. These constraints, if not taken into consideration from the beginning, can weigh heavily on the future of the environment and the resilience of some ecosystems.

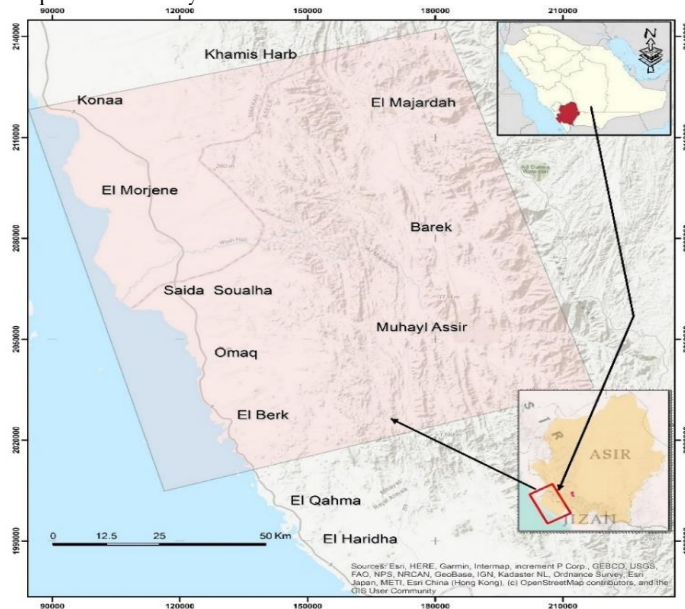
Soil, rangelands, and aquatic ecosystems composed of mangrove forests and further out to sea coral reefs, may be threatened by inappropriate management of the coastal area and its hinterland. This activity recently launched in southwestern Saudi Arabia must not affect the co-existing ecosystems by creating harmful interference or unwanted dysfunction of some of them. The second interest of this work is to answer the question: why the tourist activity does not seem to be able to develop in a sustainable way in complementarity with the hinterland (between Khamis Harb and Muhayl Asir), despite its wealth. This intra-muros space is a valuable complement to the natural wealth offered by the coastal area. The diversification of the modes of delivery of tourist products and services are at the base of desideratum and the appetite to discover new precious landscapes and new leisure opportunities, especially for foreign visitors. Today, a certain tourist euphoria is prevailing in the southwestern region due to the sustained rhythm of teamwork, state incentives and encouragement, the easy integration of the local population, the attractiveness and accessibility of the various historical heritage sites as well as the presence of typical forest pockets in the region and its surroundings. But also related to the presence of tourist guides who had received a good practical training based on a multidisciplinary approach involving the main issues of tourism and the role of actors involved in this sector (government officials, private operators, researchers, authors and editors of tourist guides specialists in monuments, museums, heritage and geomorphological

landscape), (Al-Sulbi, 2010; Hussin et al, 2014). These tour guides should be sensitive enough and conscious to the topic of ecotourism and the issue of the typical southwestern environment of Saudi Arabia. The importance of this work consists in the disposal of a database that satisfies the different actors and operators in the tourism sector. This database can serve as a basis for planning a tourism that rhymes with its environment. It is still time to adopt the necessary measures for a healthy ecotourism because most of the potentially perfectible sectors to this choice are still in virgin state. Thus, in accordance with the regional and international experiences accumulated in other countries, the actors can prevent anything that can adversely affect the ecosystems in place and prevent possible recessions that could be triggered, especially since the tourist activity remains extremely sensitive to the economic and political situation worldwide, but also to major climate change.

Study Area

The area, which represents the subject of this study, is composed of two distinct geographical and morphological clusters. The first set occupies a coastal position that forms a maritime front of 80 km and the second is located halfway up the Sarawat Mountains (Fig .1).

Fig. 1 Location Map of the Study Area.



Source: Map Available in ArcGIS Online Data Sources.

The latter, constitutes a hinterland that extends over a strip varying from 60 to 80 km. Some settlements, such as, for example, Muhayl Assir, have better exploited the opportunities offered to them from the seafront, while the settlements of El Majardah, Barek, Khamis Harb and Khamis Mtar have less developed them.

Data and Methods

Indeed, the inhabitants of Muhayl Assir fit perfectly into the coastline of El Berk more than Saida Soualha which is more in its proximity, and this is due to the availability and quality of

services. The present research is based on the combination of different methods such as field investigations, integrated spatial analysis, combining statistical and geographical data, the results of soil analysis performed by other researchers, the analysis of Google Earth images and Landsat Satellite Images multi-date and climatic data essential in estimating the climatic comfort for tourists (temperature, humidity, wind...). Indeed, the absence of direct measurements of temperature, humidity, and wind in the coastal strip between the Gulf of Saida Soualha and that of Konaa and in its hinterland between Muhayl Assir and Khamis Harb, prevents from being able to formulate a global and accurate enough performance of these different parameters in terms of climatic comfort. For this reason, a recourse to modeling was made based on four stations near the study area. Two coastal stations, one located in the south (Jizān) and the other located further north (Jeddah). Two other internal stations, the first one takes a mountainous position (El Baha) and the second one takes rather a piedmont position (Muhayl Assir). Thus, the lack of data is partly compensated by the results of modeling integrated with a spatial analysis. Hourly and daily measurements of temperature (minimum, maximum and average) and relative humidity are used in the production of the modeling of climate parameters. All climatic factors are taken every 2 hours between 1978 and 2020 (World Data.info) and will allow to highlight the disparity of effects in each entity in the study area. However, the approach gives some details about the use of remote sensing, including indices related to the calculation of Land Surface Temperature (LST) and Soil Moisture (SM). These two parameters served as a basis for a good interpretation of the share of some components of the natural environment and their thresholds of participation in the tourism process, which can guide future programs.

***An Overview of the Tourism Potential in Southwestern Saudi Arabia**

It seems essential to set up a detailed assessment of the heritage and landscape elements, considered beneficial and economically profitable to better manage the tourism process in an equitable way in the southwest of Saudi Arabia, especially in the area located between the Gulf of Omaq-Saida Soualha in the south and that of El Kouz-Konaa in the north. The tourist areas developed over the past few decades in the sectors of Al Shuqaiq and El Qahma have benefited from the many studies of development and evaluation. But it should be noted that the activity is mainly based on the promotion of furnished and well-equipped family residences, green spaces, and national parks. Knowing that this type of facilities and services better attract family tourism from the Gulf countries than tourists from European and American countries and Asian countries. On their side, local tourists prefer residences that allow them to enjoy exceptional privacy and a superior quality of life. Knowing that in their displacements, the visitors used only the private car during their holidays. It should be noted that there is no tradition of public transportation in the region.

The long-term trend of private cars may continue as basic public transportation infrastructure is scarce or entirely absent. For their part, local stakeholders have not yet taken concrete action in designing an alternative public transportation system that can substitute for the private car and meet the needs of visitors as they travel between the various compartments of the study area. The efforts to be deployed at the regional level remain indispensable and imperative to face this almost exclusive dependence on the private car, which is considered a source of pollution but also a limiting factor to the easy movement of foreign tourists. In terms of competition, it seems appropriate to focus on programs with high added value, such as lodges, chalet-hotels, golf courses, the provision of protected and ideal respite areas for nature hikers, campers, and for certain families concerned about health and the environment.

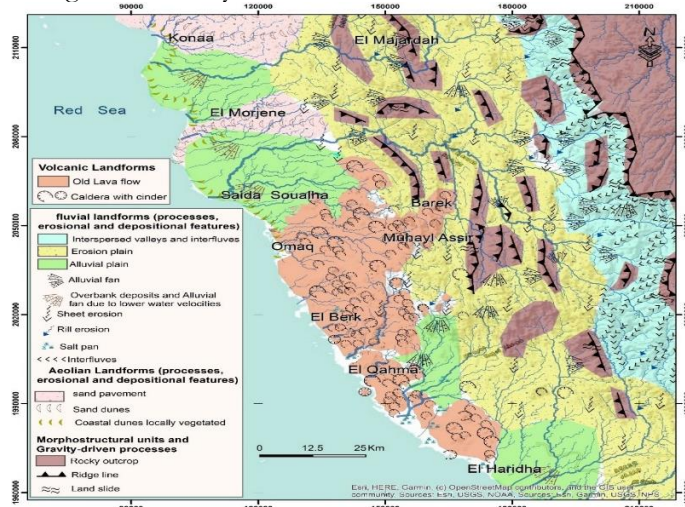
The different compartments of the study area, especially those with typical landscapes, must be adequately connected to a particularly efficient public transport system, based on the use of clean and renewable energy, and strictly linked to regional networks and sectors with exceptional tourist potential. Therefore, the promotion of various tourist circuits is one of the pilot and preferred actions to give a new impetus to the tourist activity in the study area. For, this coastal strip will effectively play a role of locomotive for its hinterland. which is seeking to differentiate and position itself in this new economic context based on sustainable development. This is the effort that requires the intermediary of competitive travel agencies, capable of providing luxury tourism services, but also while maintaining a low-cost adventure tourism for certain social classes and individuals.

These travel agencies will play a key role in the organization of holidays for visitors and in the consolidation of the tourism sector and its diversification. Knowing that the richness and diversity of the landscape offers natural amenities makes the Tihama region and its hinterland better known to visitors. In this potentially rich region, the people concerned may also have additional revenues and incomes that would arise from their contribution and efficient integration in the consecration and consolidation of cultural heritage in this promising activity.

***A Rich and Diverse Continental and Marine Geoheritage**

The study area and its surroundings encompass a geomorphological heritage formed by Volcanic Harrats typical of those commonly found in the rest of the Saudi territory. They are associated with other elements of mixed landscapes. The Harrats of El Haridha- El Berk are modest certainly compared to the Harrats of Medina and el Khaibar but not less important (Abdel Wahab et al, 2014) (Fig. 2).

Fig. 2 The Geoheritage in the Study Area.



(Source: Geological and Topographic Maps 1/20000, and Google Earth Pro Image, 2022).

This specificity comes from their direct contact with the sea, have seen the only ones in Saudi Arabia with this specific coastal position. They have long been subjected to marine influences, especially the sea breeze loaded with sea spray. This fact implies the wear, the deterioration, and the disintegration of rocks by processes related to haloclastic and oxidation on the one hand and the various effects associated with the transgressive and regressive phases of the Red Sea have evolved over time on the other hand.

The different potential geo-patrimonial sites constitute a real laboratory for the international research groups that sought to understand the link between the volcanic edifices including the associated surface patterns and the eruption styles that were at the origin of their formation. In this regard, the scientific side is added to the tourist fact. These Volcanic Harrats located parallel to the coastline, are organized in three alignments distant from the sea respectively at 2.5 km, 10 km, and 25 km.

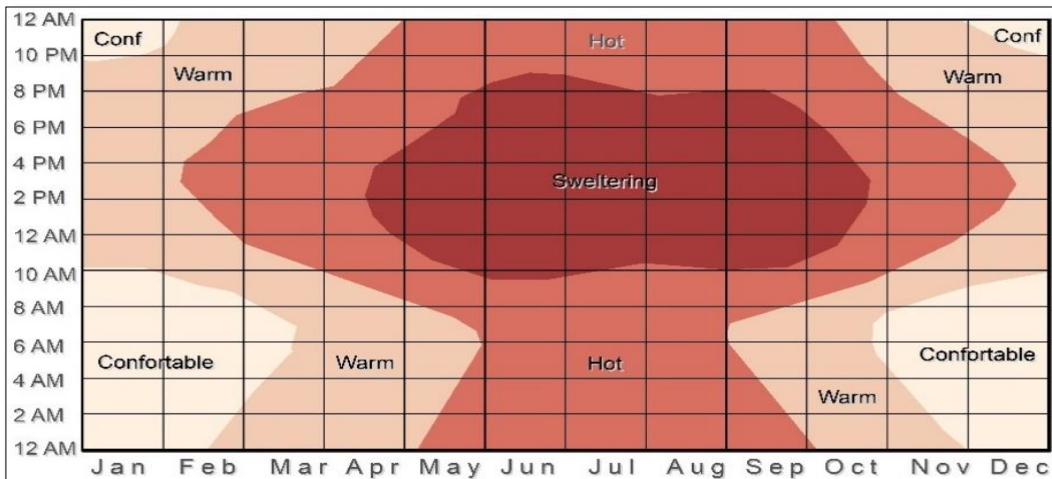
The first alignment located further south forms a belt of Harrats of El Haridha. A second intermediate alignment that of El Qahma - El Medid. It is the longest and richest volcanic geoheritage in the region, embellished and adorned with multiple circular craters and some crescent moon shaped (Moufti et al., 2012). The third alignment of Harrats extends between El Berek and El Omaq. It hosts the lowest, most worn, and most scattered craters in the region (Fig. 2). This pronounced wear is indicative of a partial crater collapse followed by a very active physical-chemical weathering action and the proliferation of various erosive processes that reflect the combined effects of the watercourses and the prevailing west and southwest wind (Fig. 2). On reaching Muhayl Assir and Bareek, we witness a disappearance of "Harrat", only a few volcanic mountains punctuate the geomorphological landscape, the most important of which is the mountain El Hila which takes the middle position in the landscape.

***The Climatic Advantages of the Study Area**

The entire western strip of Saudi Arabia located below the steep western slopes of the Sarawat Mountains is the most temperate in the country in winter, but the hottest in summer. Apart from some disparities related to microclimatic nuances that may influence the length of the tourist season, given the topographical complexity of the hinterland (Azaiez et al, 2022). The region of El Majardah and Bareek are largely known for winter and spring tourism, and this is thanks to its topographic position that shelters it from the cold winds striking from the north and northeast.

The majority of tourist flows include native city visitors. These hinterland areas are still ineligible to receive foreign tourists on a regular basis and in significant numbers, due to the modest tourist infrastructure, despite the richness of the area and the long, pleasant period lasting between 5 and 6 months as well as the unspoiled nature, especially in terms of comfort (Fig. 3).

Fig. 3 Average Hourly Temperature in El Majardah city



(Source: Modelling of Climate Data 1978-2020).

It was necessary to think about a better distribution of tourist flows in space and time and, therefore, requires special attention in the planning of future tourism programs and in the way of designing structural solutions for existing tourism projects. Thus, it seems important to consider a typology of sites in terms of assets, service, seasonality, infrastructure, accessibility, possibility of valorization, degree of involvement of the population and regional decision makers to on ongoing process of cooperation, in order to provide lessons on the management of tourist flows for urban planners, transport planners, but also for those who have a privileged position for nature. Taking all these facts into consideration will translate into a concerted effort to be made at the regional level to implement the agreed elements of an appropriate tourism strategy (Al Slimane, 2017).

The tourist circuits must connect, as much as possible, all the sites that have natural assets (geomorphological, topo-climatic, forestry, maritime) and human assets consisting mainly in a range of traditions, cultures, and socio-cultural practices. On a temporary scale, the region offers the possibility to promote tourist activity spread over four seasons. The two regions of El Majardah and Bareek receive more visitors in winter. This is the same case for the developed coastal belt between El Qahma and El Haridha, where the beaches of El Berk are crowded in winter, especially on holidays and weekends.

Out of 300 families surveyed, we found 80% prefer to spend the whole day in the beaches of El Berk thanks to the availability of services, the quality of the beaches in the immediate vicinity and the very favorable thermal atmosphere. While the category of doctors and businessmen, representing 20% of respondents prefers the residences equipped with swimming pools of Al Shuqaiq -El Qahma, especially during the spring and summer weekends.

A Very Contrasting Thermal Environment

Based on the hourly temperature modeling of the five stations, it was found that thermal comfort must be studied on both levels (daily and seasonal). On a daily scale, a distinction is made between daytime and nighttime comfort, which can have a significant impact on tourist activity and the daily behavior of visitors.

Thermal Comfort At Night

Thermal comfort, especially at night, is closely linked to the rate of terrestrial radiation (Besancenot, 1990). As a result, the mountain resorts are characterized by a summer thermal comfort at night, which begins at the end of May and continues until the end of September for the two resorts of Namis; El Baha and Abha (WorldData.info, WeatherSpark.com, 2022). The period of thermal comfort at night is even longer for the station of El Baha (one month longer than Namis).

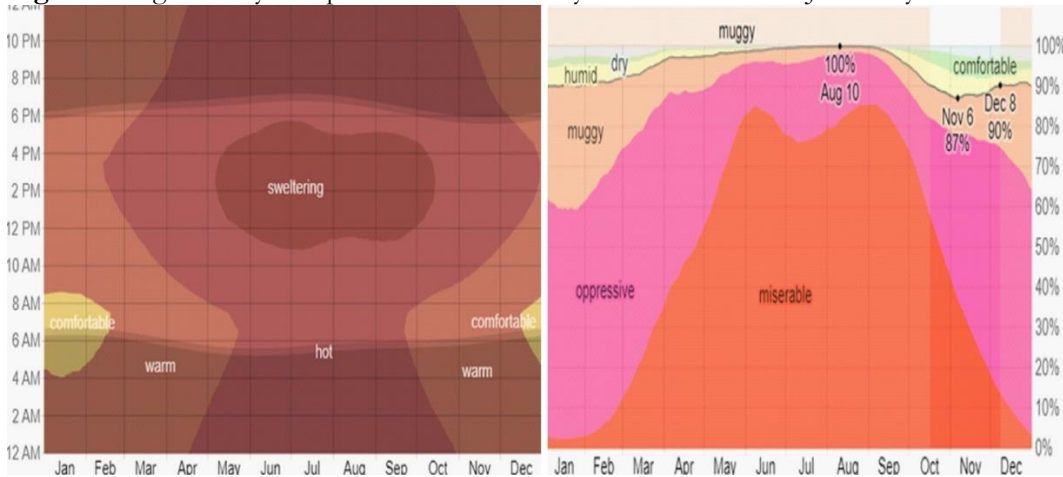
Otherwise, the cold is felt for both seasons winter and autumn. This fact is attributable, in large part, to the altitude and exposure. On the other hand, in the coastal stations between Quenfudah and Jizān, the thermal comfort at night is even less important because the temperature is expected to be maintained at higher levels due to the increase in relative humidity over 80% of the days and of the year (water vapor which maintains much of the latent heat). However, the heat stress situation is even more difficult and critical during the summer (World Data.info, Weather Spark.com, 2022) (Fig).

Thermal Comfort Diurnal

In the mountain stations, the thermal comfort during the day extends respectively over one and a half months of winter, two months of spring and one and a half months of autumn,

especially in the station of El Baha. In the other two stations, the situation is similar in terms of seasonal distribution, only it should be noted a slight delay of thermal comfort during the winter for the station of Abha. As for the station of El Majardah and that of Jīzān, the absence of absolute thermal comfort is a real constraint and handicap for summer visitors and summer residents (Fig. 4).

Fig. 4 Average Hourly Temperature and Humidity Comfort Levels in Jīzān City.



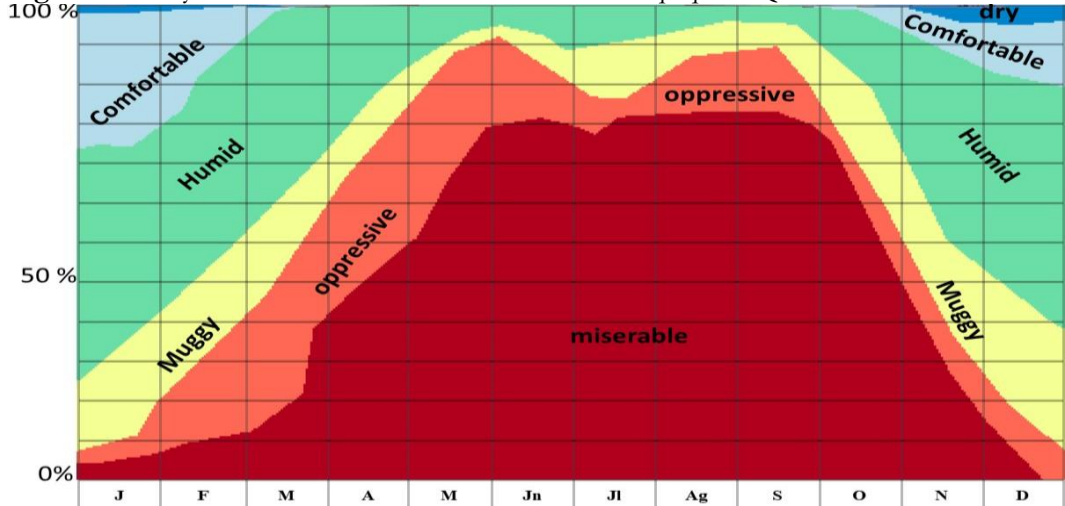
(Source: World Data.info).

This fact is related to the high humidity primarily in the station of Jīzān and secondarily in the station of El Majardah. The latter is affected by the mountain breeze and the valley breeze. The results showed that 25 families stated that they spent 2/3 of their holidays in the hotel or in the residence. While the remaining 1/3 of the holiday period was divided between daily supply and visiting the place. It seems that the contact with the nature by wandering in all quietness in the forests, the farms, the islands, the geo-archaeological sites, and the forests of mangroves remains insufficient to discover the richness of the region and to create a driving effect on the economy of the region. From the perspective of TOCCI (Tourism Climate Comfort Index), it should be noted that the coast between Jīzān and El Qahma knows a torrid temperature from spring and accentuate more in summer.

A comparison between the period 1978-2000 and that of 2001-2021 shows a deterioration of climatic comfort in summer on the entire southwest coast, where the maximum temperatures recorded, and relative humidity levels are far from allowing maximum comfort to tourists because of the scorching heat associated with unbearable humidity (Fig. 4). The situation worsens further if accompanied by occasional gusts already strong enough to activate sand and dust storms, considered considerably harmful to the tourist facts.

Based on the processing of data obtained from (World Data.info, Weather Spark.com) for the station of Jīzān on the one hand and the modeling of the two climatic factors (temperature and relative humidity) of the coast El Qahma - Al Shuqaiq, on the other hand, shows that the situation of comfort is perceptible from mid-December to mid-February and only during the early hours of the morning (between 4 am and 8 am). On the rest of the days of the year, the temperature remains below 30 °C (Figs 3 and 4) and the humidity between 90 and 99% (Fig. 5).

Fig. 5 Humidity Comfort Levels in The Coast of Al Shuqaiq - El Qahma.

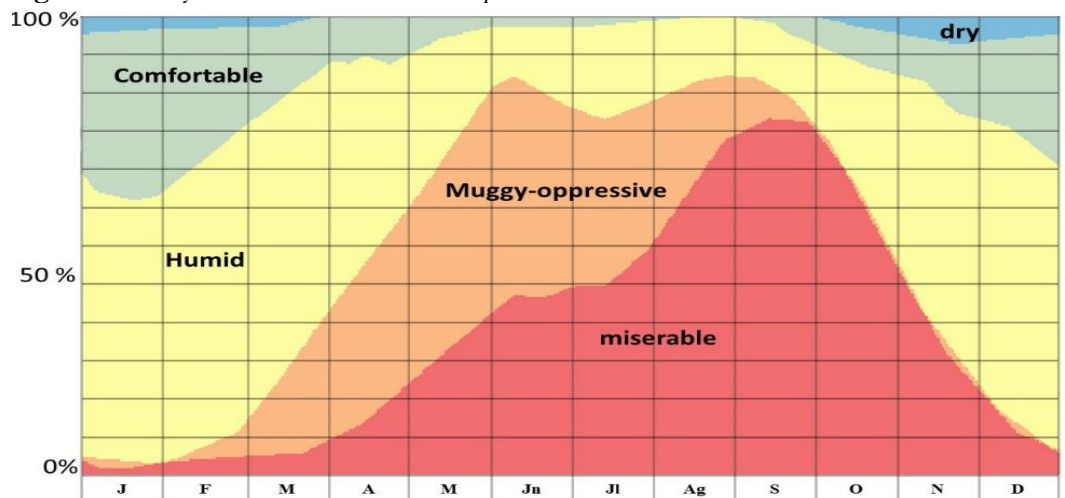


(Source: Modelling of Climate Data, 1978-2020).

This fact is judged at the origin of short holidays in Jizān, which do not allow to the visitors to discover all the wealth of the region continental and maritime. Indeed, this coast is sought after for its tranquility, panoramic landscape, traditions, and biological diversity, but the feeling of comfort was limited to four hours only, between 22:00 and two o'clock in the morning. A survey was conducted among 30 families including 10 indigenous families and 20 foreign resident families who visited the Jizān and El Qahma coast and its hinterland more than twice.

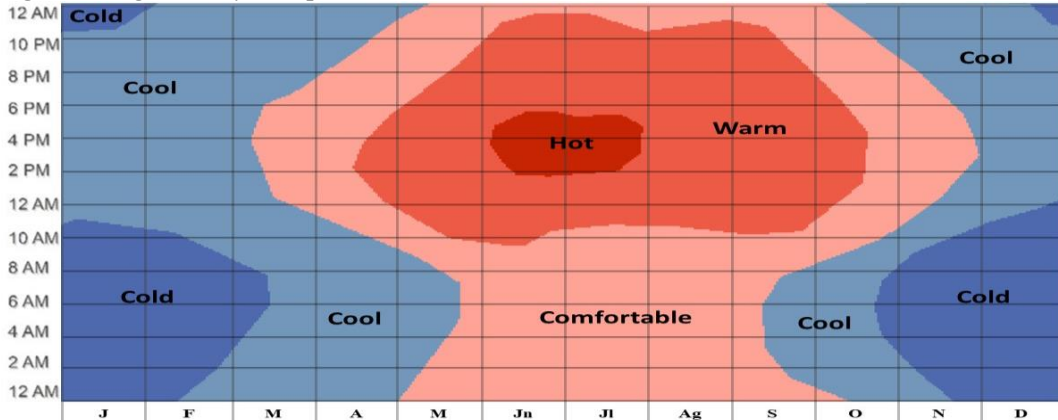
The modelling and the analysis of the results underline important differences between the southern coast and that of Omaq-Saida Soualha - El Konaa from the point of view of comfort also from the point of view of inherent potential. Indeed, the situation of climatic comfort is less oppressive on the coast of Omaq-Saida Soualha (Fig. 6), where the period of comfort can extend over three months more than the area of Jizān and Al Shuqaiq - El Qahma and their surrounds (Figs . 4, 5 and 6).

Fig. 6 Humidity Comfort Levels in Omaq-Saida Soualha Coast.



(Source: Modelling of Climate Data, 1978-2020).

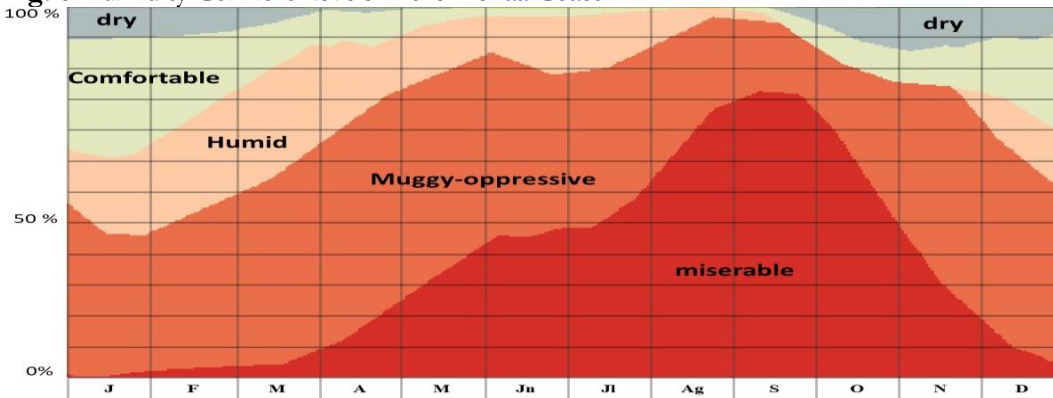
Fig.7 Average Hourly Temperature in the Khat Basin.



(Source: Modelling of Climate Data, 1978-2020).

This advantage will reduce the pressure on the south coast, as the first tourist destination of the country with all the negative effects induced because of the strong use of the private car which accelerated more the sensitivity of the intermediate ecosystems, such as the water courses, the ground water, the Mangroves and in an indirect way the marine ecosystems close to the beach, especially, the coral reefs whose sanitary state will be moreover worsened by the extension of the area of the degraded mangroves. The climatic comfort improved even more as one approaches the slopes of the wadis Khat, Khatabah and tributaries of the wadi Hili which are endowed with a certain freshness provided by the effect of altitude and the alternation of the mountain breeze and the valley breeze (Besancenot, 1990). The torrid temperatures are not only rare, but also limited to a few hours of the day (between 14 hours and 15 hours 30 mins) (Fig. 7).

Fig. 8 Humidity Comfort Levels in the Konaa Coast.



(Source: Modelling of Climate Data, 1978-2020) on its Part, the Remote Sensing, With All the Processes and Data Processing Possible under arc Gis, it has Been Possible to Emphasize Another Dimension of Thermal Disparities, but this Time at the Level of the Ground. It is a Question of Exploiting the Potential Offered by Landsat Images In The Estimation of Two Indices of the Temperature and the Humidity of the Soil, Because these are the Two Indices That Condition The Thermal Environment in the Lower Troposphere Without Considering the Additional Thermal Contribution of Greenhouse Gases of Anthropic Origin Coming from the Exorbitant Use of the Private Car.

Estimation of Thermal Comfort Through Lst and Soil Moisture Indices

Great interest has been given to the temperature in the lower troposphere as well as at ground level, as they are considered as two parameters limiting tourist activity and repressing foreign visitors, especially in the case of extreme and annoying temperatures. Summer visitors and hikers are the most affected by extreme temperatures, especially in case of lack of shelter during excursions and in difficult sites. Indeed, the LST index is another parameter that has served as a basis for establishing a situation of this new tourist front that offers two different tourist landscapes. A seafront interspersed with constant flat beaches and rocky outcrops sloping gently towards the sea and ending with scree deposits. A second landscape of hinterland with a progressive reinforcement of a mountainous climate rather contrasted. Knowing well that the weather stations are less numerous, recourse is made to the modeling of this index, given that the earth's atmosphere is heated largely from terrestrial radiation. However, the later mentioned is influenced by the soil moisture content, its occupation, and the vegetation cover rate. It is through the combination of hourly measurements of relative humidity and atmospheric temperature on the one hand and the estimation of two indexes (LST and SM) that the different climatic ambiances could be determined. This allowed to establish a spatial typology that could be used in the establishment of a predefined calendar, especially for organized trips. All the previously mentioned indexes are essential for the determination of the ideal conditions of climatic comfort according to the site, the situation, and the altitude (coastal sectors, mountainous sectors; anticyclonic blocking, sandstorm, extreme heat).

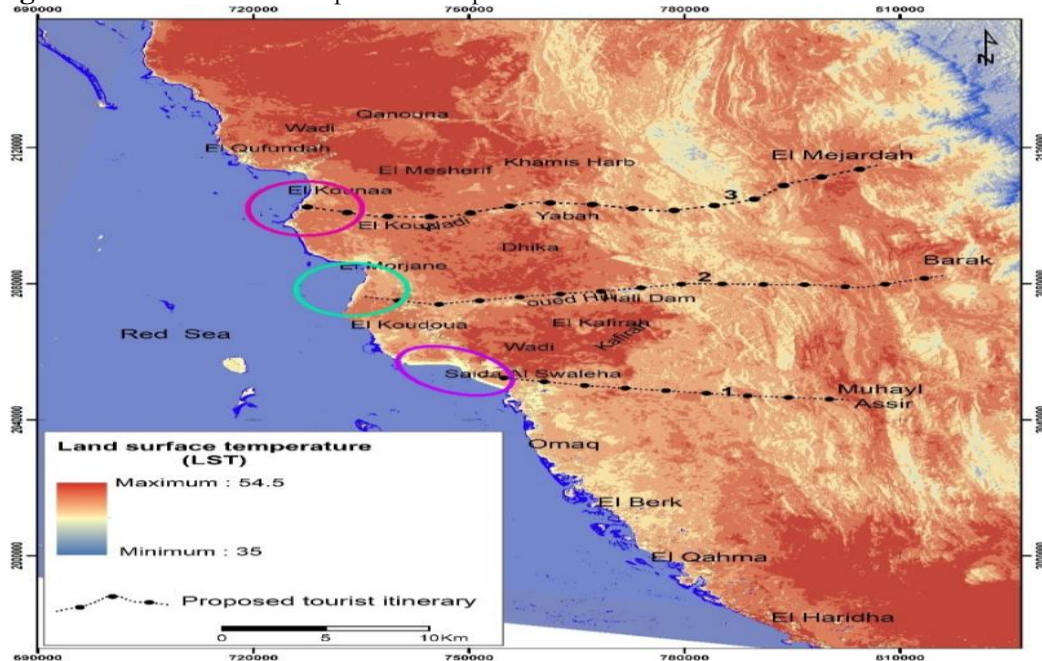
All these parameters have been taken into consideration to determine with more precision the best daily and seasonal moments, the most favorable for tourist adventures, especially for summer visitors and hikers. The detailed study of this fact allows to carry out an efficient tourist investment based on solid foundations and very well planned to ensure an economic growth sufficiently supported by the various local and international stakeholders, which rhymes with nature and at the same time allows visitors to optimize their stay according to the opportunities offered. The modeling of the variations of the atmospheric temperature, humidity, and the index of the temperature at ground level (LST) of all the south-western coastal strip as well as its hinterland made show that the climatic environment between the gulf of Saida Soualha and that of Kounaa presents climatic conditions much more favorable for possible new tourist activities compared to that of Al Shuqaiq - El Qahma (Fig. 9).

The average LST index value was calculated based on 20 Landsat images representative of the four selected seasons between 2017 and 2022. The modeling process has highlighted two major heat islands on either side of the El Berk and Saida Soualha area. The first island is that of El Qahma- Jizān. The second extends to the area of El Quenfudha and especially to its northern surroundings. A second intermediate island extends between El Kafirah and Dhikah, but its influence on thermal comfort is less, especially in winter. The areas bordering the north and south sides of the study area show extreme values of ground level temperature, suggesting disturbances in the tourism calendar.

This condition of thermal rising marks all the southern band between El Qahma and Jizān and the islet of El Quenfudah which have the highest values in southwestern Saudi Arabia (54.5 C°). The compartment located between El Berk and Saida Soualha Bay records the most moderate averages. These values only weaken further near the Khat-Khatah and Hili wadi watersheds and the El Majardah and Bareek areas. This climatic advantage allows us to propose new ways to establish a more varied and equitable tourist activity that considers the specificities of the seafront and its hinterland. In addition to the seaside activity, it is possible to think of

other tourist circuits that offer great opportunities by integrating the different entities of the region and involving all components of society in the implementation of a low-carbon tourism model.

Fig. 9 The Land Surface Temperature Map of the Southwest Coast and Its Hinterland.



(Source: The Output of the Modeling Results According to the Landsat 8-9 OLI/TIRS C2 L2 260 Images of 2017-2022).

This is possible thanks to the injection of young talent, new ways of approaching things and new techniques of the tourism industry more adapted to the environment. The new alternative and complementary tourist destinations will have to be defined not in opposition to the existing destinations or in terms of competition (from Jizân to El Qahma), but rather in complementarity with the tourist areas that have emerged over the past decades (Al Shuqaïq-El Qahma). The development of sustainable ecotourism is of paramount importance for the region and for the country. It requires a small step on the part of the stakeholders, but it will represent an important step for the environment. When the area is first developed, tourism activity in the area will be in strong competition with Al Shuqaïq to the south and El Quenfudah to the north. However, it will be a suitable choice for future projects because of its low susceptibility to natural hazards (summer heat wave, occasional flooding, less frequent dust storms and very little threat to mangrove or coral ecosystems...). Indeed, the entire developed area north of Jizân is part of the alluvial plain of the wadis Bish and Byadh (Abdelkarim, 2019), El Hroub (Azaiez, 2021). As a result, it is commonly subject to spring and summer flooding which are favored by the morphometric conditions of the watersheds on the upstream course (Azaiez, 2021), the occurrence of potentially torrential rains (PTR) (Allaoua and Azaiez, 2021), the very fine texture of the soil with low permeability, the low slope and the construction of the road that has largely disrupted the natural drainage of runoff from more than 45 watersheds.

Before embarking on new macro-regional projects, a preliminary and detailed diagnosis of all existing tourism projects, including infrastructure, must be carried out to avoid repeating the

same mistakes and to set up ambitious and effective tourism projects, particularly in terms of the environment. This first step also includes the evaluation of the competitive performance of each tourist destination based on an analysis of the attractiveness of the landscape, the efficiency of the facilities and the pre-existing tourist offers. These are the primary tourist offer (climatic and landscape potential) or inherited (, forest, coral, and cultural heritage). It is very important to focus on accessibility, governance, and the adhesion of the local population to this effort by getting involved in the promotion of green finance and the exploitation of new techniques and talents.

Results and Discussion: Environmental Challenge

Until today, players in the tourism industry on a global scale, as well as on a regional scale (southwestern Saudi Arabia), have not invested in a fully sustainable tourism infrastructure, including in the transportation sector, the main source of pollution in the world. The issue of transportation remains a sensitive and environmentally embarrassing one, especially for tourists who rely heavily on various means of transportation to get between the various sites on their travel circuit. Moreover, almost the entire coastline of Al Shuqaiq-El Qahma, that advances the Harrats on the seafront is paved with sidewalks (Photo. 1). Rock dikes, walls and gardens are put in place. These different concrete developments prevent any restoration of the coastline in its natural functioning because the coastline finds its balance in its dynamics (low and high tides, littoral drift, terrigenous deposits). (Karus, 1988; Iwan Le Berre, LETG, UMR6554 CNRS, IUEM-UBO, 2020).

Photo .1 Examples of Landscaped Coastlines in the Study Area.



(Source: Jīzān Municipality: Media and Institutional Communication Portal).

In landscaped areas, the entity of the foreshore, as a highly mobile and dynamic sector, is completely erased from the landscape, therefore the perpetual exchanges of the sea-land system and the associated processes that take place at different spatio-temporal scales will be interrupted forever (Iwan Le Berre, LETG, UMR6554 CNRS, IUEM-UBO, 2020). In the past, this buffer space between the terrestrial and marine domains is intrinsically dynamic through exchanges of transverse sedimentary flows materialized by terrigenous inputs in the form of sediments or soluble in the form of dissolved minerals) and longitudinal exchanges ensured by the littoral drift coastal currents, wind waves and swells (Pascoff, 2010) and which consists of a reworking and a remobilization of the sediment which obeys at the same time the various discontinuities of the shoreline and the interaction between the dynamic agents of the littoral

sector. This moving interface is also independently linked to the geological nature, to the amount of energy dissipated by the hydrodynamic agents (currents, rivers, wind, swell, drift).

Depending on all these complex agents, the foreshore plays a major role in maintaining global ecological and hydrological balances (Daligaux, 2003). It should be noted that coastal developments (infrastructure and tourist buildings) must take into consideration the random characteristics of the swell in terms of direction, amplitude, return period and wavelength because it reflects the transfer of energy from wind to water and propagates differently depending on the bottom water topography and energy dissipation on the shore. Indeed, coastal developments, although they offer a good spatial organization in terms of accessibility and amenities and landscape beauty for users (local and foreign), they are generally implemented based on an often-insufficient knowledge of the dynamics of the land-sea system, especially, of the intertidal zone (Karus, 1988; Pinot, 1998). Another methodological weakness is the lack of a serious assessment of the responses of coastal ecosystems to variations in the various uses of the coastal area (particularly tourism). Only impact studies can give an explanatory and predictive dimension of the different interventions to encourage the development of a concerted and sustainable use of this extremely sensitive coastal area (Martínez et al, 2007; Nakhli, 2010), and which are not immune to global climate change. The impact of tourism units and infrastructure that have been implemented can be perceived at three different spatial scales in relation to shoreline distance: distal, intermediate, and proximal. First, proximal impacts that may occur in the short term near the coastline include algal blooms and multiplication of certain pathogenic organisms (Kraus, 1988), degradation of coastal waters, tidal dysfunction, eutrophication of coastal ecosystems, and consequently rapid retreat and degradation of mangrove species that have long marked the western coastal landscape. As for the undesirable intermediate impacts, we are mainly talking about the problems that can attack the coral reef systems which are extremely sensitive to biotic and abiotic stresses that originate in shallow waters and progressively spread towards the depth. Indeed, coral reefs commonly settle in privileged sites between deep waters and shallow coastal waters, on a rocky bottom characterized by clear and quite warm waters. They play a double role (Dodge et al, 1977; Dodge, 1978; Chancerelle, 1996; Aronson and Precht, 1995). On the one hand, they constitute a natural line or barrier to protect beaches against the mechanical effect of water (waves, tornadoes, swells, longshore drift...) (Paskoff, 2010).

These reefs exert the effect of high ground slightly distant from the shore. It allows a slowing down of the waves' breaking and consequently a fattening of the beaches on the mainland side. On the other hand, they also offer an excellent habitat for certain marine species and micro-organisms live and cohabit in symbiosis with them (Goreau, 1977; Fagerstrom, 1987; Heiss, 1994). Coming to distant impacts, but this time in the positive sense, coral reefs are also the basis of two economic activities of primary importance. On the one hand, fishing (corals are very expensive products) and on the other hand, the tourist attraction (diving) as it is at the head of the sectors asse sought by scientists and it is thanks to its healthy environment for the preservation of corals. For this reason, the Red Sea has become a privileged learning and educational area for the scientific community.

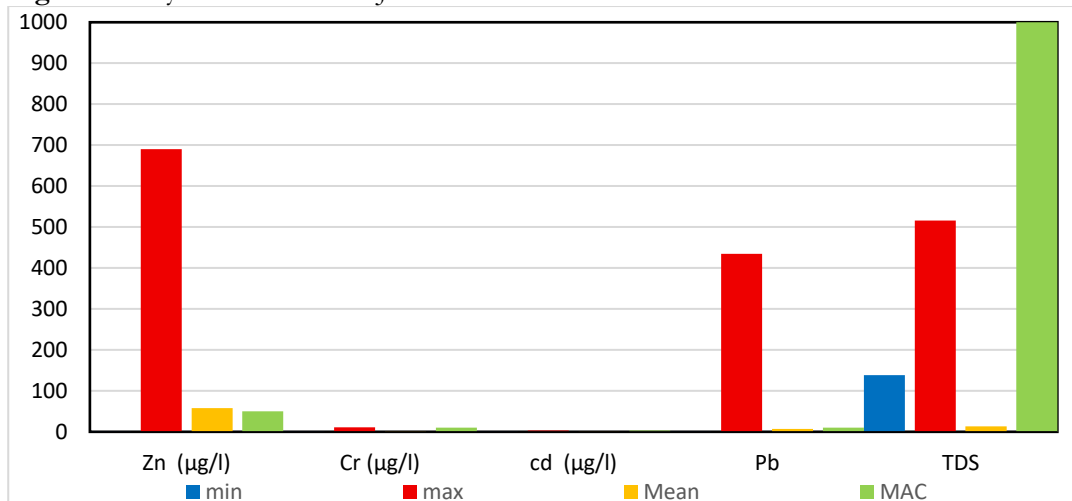
Another particularity of the southwestern area consists in its division into small watersheds with exoreic flow whose drainage has become difficult in some areas and disrupted in others, as a result of the development of coastlines and infrastructure. It is through these small streams that a large amount of soluble minerals from the (volcanic) rock outcrops are transported to the sea. Indeed, the alteration of basaltic rocks that cover the ancient, consolidated lava fields

of the Cenozoic (Harrats), generates a release of heavy metals, formerly drained to the sea, and quickly sequestered in the leaves and roots of Mangroves, Doumes and Choura, all of which have a highly developed root system that does not allow the passage of the slightest metal element. Currently, the terrigenous contributions have not reached the sea more than before, because of a backflow of water caused by the counter-slopes, the inadequacy of the drainage system and the installation of tourist and agricultural infrastructure not appropriate to the hydrodynamics of the region. Two combined facts arise in front and behind the sea. On the one hand, soil and groundwater contamination has occurred on the continental side (Al-Boghdady and Hassanein, 2019; Alzahrani et al, 2022), and on the other hand, a sediment shortage has affected most of the mangrove ecosystems that are disconnected from continental hydrosystems. Only small amounts of sediment are carried to the shoreline by drainage channels due to sidewalks and embankments. All these structures have replaced the fringing dunes that functioned for a long time as basic moisture conditioning elements for the Mangroves during low tides. Consequently, an increased concentration of heavy metals that remain trapped in the soils against the backs of the various structures previously mentioned. A fraction of these elements will be leached and progressively carried into the water table, in quantities proportional to the state of permeability of the different soil compartments. According to the results of the analyses carried out by other researchers, a degradation of the quality of groundwater and pollution are being prepared in some areas, while in others, the pollution of the water table now seems to have increased to reach critical thresholds for some elements of heavy metals (Alzahrani et al, 2022; Al-Boghdady and Hassanein, 2019). This is a very worrying finding considering the results of research based on the analysis of water samples taken from 38 wells and soil, which showed a level of heavy metal contamination below the permissible limit for most samples, especially those taken in areas that have benefited from the establishment of tourist infrastructure.

According to specialists, there is no other alternative to reduce this contamination at the soil level than facilitating the drainage of water to the sea through a system of ditches and transverse drains directed to the sea and intended to convey large volumes of water, but also sediment. Arriving at the sea, comes the role of mangroves that will get rid of heavy metals dissolved by sequestering them in the storage organs (roots, trunks, and leaves).

In the same context of pollution, hydrochemical analyses made on water samples taken from several wells on the outskirts of the El Quenfudah area and in the extreme north of the Jīzān plain, as well as soil analyses showed contamination that sometimes exceeded the accepted tolerance standards known as maximum allowable concentration (MAC).

It seems urgent to think of an adequate and sufficient drainage system to evacuate large quantities of additional water during heavy rains and which are of great occurrence in southwestern Saudi Arabia. The level of Zinc (Zc) of (695 µg / liter) was more than 15 times of the tolerance threshold set by the scientific committee of chemists that is (48 µg / liter). With a more pronounced risk comes that of Lead (Pb) with a maximum rate of (438 µg / liter) and which is recorded in three points in the southern vicinity of the plain of El Quenfudah, while the MAC threshold is about (2 µg / liter). This rate represents more than 220 times the tolerance threshold, which is considered enormous for the existing ecosystems, especially the natural vegetation of the rangelands. However, we must reproach the observation a little since the average remains below the accepted norm. It is of the order of (1.48 µg / liter) (Alzahrani et al, 2022; Al-Boghdady, 2019) (Fig. 10).

Fig . 10 Heavy Metals in Soil of Jīzān Plain.

(Source: Résultats Des Analyses Chimiques Faites Sur Des Echantillons De Sol Prélevés Dans La Plaine De Jīzān (Alzahrani Et Al, 2022 ; Al-Boghdady, 2019).

What means that the contamination remains punctual and localized in space. It concerned precise sectors in which the local authorities can intervene effectively and the chance to catch up is still possible. The polluted sectors are in the alluvial plain of Wadi Hili and precisely in the fields where the farmers have built dikes and levees in an archaic way to retain the flood waters in their agricultural plots. Knowing well that no exceedance of the Saudi standard in force regarding the measurements of the element of Cadmium as a by-product of the metallic fusion obtained industrially from the anthropic activity.

On the other hand, the soils north of the Jīzān plain were very severely enriched in Cu and Pb and moderately affected by Cr. Alzahrani has showed that natural sources of pollution in Cr, Mn, Fe, Cd and Ni is caused by the continuous wear of rocks and anthropogenic sources of pollution for Cu, Zn, Cd and Pb. Even if crystalline rocks give rise to high concentrations of chromium, copper, nickel and zinc, these heavy metals are not only of natural origin coming from the alterations of the said rocks, but they are also introduced by anthropic activities. In first order comes the mass motorization. Automobile traffic generates mineral dust because of driving on the ground which is largely bare (runway and beach sand, dunes), which causes a suspension of crystalline silica dust and quartz particles, considered harmful to human health and coastal ecosystems (Degobert, 1992; Algahtany, 2000; Kuété, 2002). According to the same researcher, the wear of tires and brake and clutch linings, which contain a certain amount of asbestos fibers in their structures, can also contribute to this pollution. This asbestos component can be crumbled into asbestos dust of about 7 microns in size, which is very harmful to health. (Degobert, 1992).

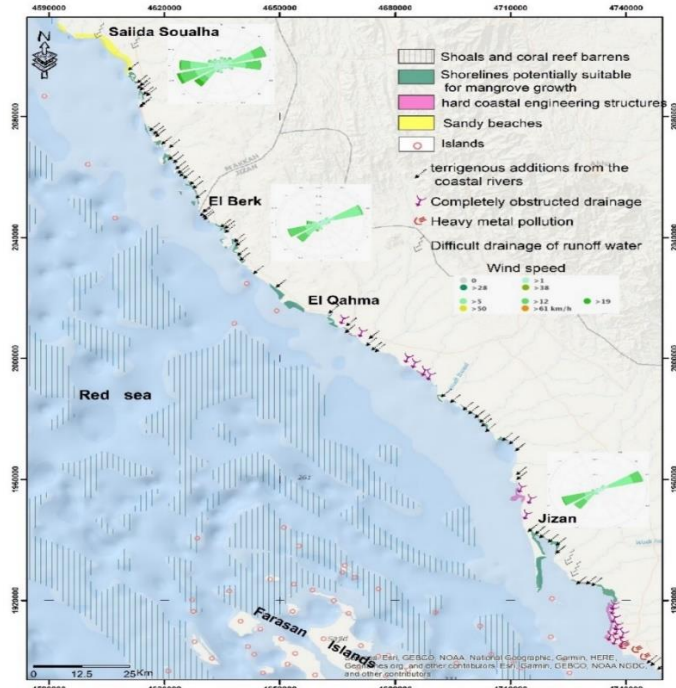
Another confirmation of the proliferation of this risk of human origin, comes from the analysis of the investment map of Assir which mounted that 95.55% of tourists used the private car in 2018 with an increase of 2.5 times during a single year (between 2017 and 2018) in the two regions of El Majardah and Muhayl Assir. This fact could also be confirmed by the preferred destination of tourists who visited El Majardah and Muhayl Assir between 2017 and 2018. The latter stayed either in private residences or in well-equipped hotels. The visiting groups were hosted in private residences (Abha, Chamber of Commerce and Industry, Research, and

information center, 2020). The number of people hosted was about 233085 while the share of hotels was only 2899 trips or almost 80.5 times less, which reflects a low use of public transport considered less polluting than the private car. Until these years, there has been no serious attempt to significantly reduce fuel use and to hide the problems caused by the car.

*Mangrove Degradation

The tidal swing zone, as a habitat for Mangroves, has been deeply affected in the tourist areas between Jīzān, and El Qahma (Suratman, 2008). The processing of Landsat images showed a concentration of this typical vegetation in these areas. This situation of uncertainty may put them at increased risk in the long term if the commitment to green investment is not enforced. These plant species, which are partially submerged by tidal waters, require fresh water from a multitude of exoreic streams. With tourist facilities and associated infrastructure, drainage may become increasingly difficult, which ultimately threatens the sustainability of this ecosystem, which will be more essential than before in protecting beaches from global climate change (Degobert, 1992). Therefore, a serious effort to catch up must be made before reaching colossal imminent damages and irremediable environmental situations. It seems extremely necessary to establish a typology of the coastal space according to the different discontinuities of the shoreline, their exposure to the different dynamic agents coming from the open sea (waves, swell, winds, drift) and the density of the islands and the coral reef barriers. The determination of all these facts will allow to delimit the sectors potentially favorable to the development of mangrove species and the other spaces that are likely to be problematic (Fig. 11).

Fig. 11 Landscape and Processes Exchanges of the Sea-Land System in the Study Area.



Source: (World Ocean Base on Arc GIS Program and Meteoblue Database).

Generally, mangrove habitats develop on the coasts best protected from swell, waves, and wind. They are located preferentially, but not exclusively in bays, estuaries, and river outlets.

On its side, the presence of an insular system plays a primordial role in their protection, and due to the damping effect of any aggressiveness coming from the sea. The privileged location near the mouths of rivers, is explained by their need for sediment, fresh water and organic matter and minerals, which are necessary for their development.

The Coral Reefs At Beginning of Degradation

Indeed, the few bacterial diseases that can attack coral reefs, such as cyanobacteria, white syndromes and skeletal alteration of corals are hardly noticeable or even rare in the Red Sea (Christian et al, 2019), especially in the southwestern sector. These few disturbances witnessed a threat that is being prepared, due to the sensitivity of ecosystems to climate change. These facts are closely related to new uses of the coastal space, which remained as an isolated space and in a virgin state for a long time and now reveals itself as a space too sought after for tourist investment especially after the opening of Saudi Arabia on external tourism. It is time to rethink this space in terms of governance to know the order of priorities of the tourism strategy which continues to be in favor of the economy at the expense of the environment. The various facilities and tourist units set up are hardly representative of a sustainable tourism infrastructure (Som and Al-Kassem, 2013; Van and Viet, 2019). Will it be possible to develop a less water consuming tourism infrastructure?

Golf courses, swimming pools, water features and fountains are at the origin of the high-water consumption worldwide, now they are also the basis of the tourism industry. The most sought-after tourist destinations worldwide are those that offer the most diversified activities in a healthy and safe environment. Regarding the study area, it should be noted that most private tourist residences are equipped with multiple swimming pools, designed in a way that guarantees the respect of the privacy of families. This suggests an eminently water-intensive tourist activity. In the hotel units the tourist processes are based on some common pools between the different users. Instead of one or two pools, it will be necessary to set up a hundred pools. This means the consumption of large quantities of water, which poses the problem of the scarcity of this resource in a particularly arid country. The loss of water has become more and more grandiose. It comes first from the pronounced drought and its waste in the filling, the renewal and in the compensation of the evaporated water in the swimming pools. Splashing, diving, water games and evaporation in the case of uncovered pools participate in their part in this loss. In fact, even if the pool water is generally renewed in part every year, this is not the case for hot countries insofar as the renewal consumes more than 1/3 of its total volume every year (Hamilton et al, 2005). Other facts that are not of lesser importance are the sand and dust storms that can strike for several days of the year and the acid rain that can also be the basis of renewal or refinement of the water because of the pollution involved. The question that emerges is whether there are innovative tourism procedures or techniques that would allow us to do two things at once, on the one hand guaranteeing the recreation and development of tourists and on the other hand ensuring the sustainable economy of water, or are we simply going to ban swimming pools in the long term in the context of serious climate change?

This last solution would be imperfect and inadvisable for Saudi Arabia because it allows competing countries, although less powerful financially and less rich in Geoheritage and Geoparks, to take advantage of this fact, to put themselves in its place just because they offer the complement of swimming pools and water games (aquaparks), which have become very fashionable. Thus, in the face of the growing global competition, from the point of view of the quality of tourist services and instead of banning swimming pools or reducing their number, it is necessary to orientate the choice towards the implementation of covered swimming pools,

which will reduce evaporation and their pollution, however equipped with an innovative and very effective aeration system in the control of the quality of the water. It is also necessary to engage towards a reuse of the water of the swimming pools through specific treatments and adapted to the standards of Saudi Arabia.

Conclusion

In recent years, the coastal zone of southwestern Saudi Arabia has received increasing attention. Studies have multiplied to highlight its economic and environmental importance to reach concerted decision-making actions for substantial and effective geo-patrimonial development. Through this study, it was found that tourism activity in the southwestern sector of Saudi Arabia is still at a rather embryonic stage, although it is in full emergence. The opportunities are considerable and widely diversified. However, it should be noted that the demand remains restricted to residents and those of the golf countries more than foreigners, due to the modest infrastructure, especially public transport, and the lack of coordination, complementarity, and coherence between the various tourist destinations despite the competitive and invaluable assets that represent its regional diversity. The foreign visitors represented only 4% (Al Sliman et al, 2021). Compared to neighboring countries that have recently engaged in tourism competition, Saudi Arabia's potential remains as immense as its territory, provided that certain environmental measures are put in place to protect the coastal and mountain ecosystems. Therefore, the tourism experiences of other previously integrated countries in this field can be a source of inspiration for the new generation and motivate the contribution of new skills and talents to the service of their countries. These experiences can also serve as lessons to prevent possible impacts on the environment and to foresee the appropriate strategies to follow in each environment, especially the coastal habitats that are the most sensitive and seem to be victims of pollution and inappropriate tourist facilities. Reason for which, it is necessary to attack upstream directly on the causes by intervening in an early phase to know how to solve the problem, better to intervene late downstream at the level of the consequences, judged unfortunately, sometimes, unavoidable. It is advisable to create a control system that will take care of the contamination points that must be under continuous monitoring to evaluate the risk and to orient the next strategies of tourist development in harmony with their environment. Some measures must be taken to design a tourism project in its entirety, capable of strengthening a more diversified economy to the region and to acquire new skills in the field of tourism industry. Among the solutions that have been proposed to remedy the effect of pollution of Jīzān plain and groundwater caused by tourism facilities and concrete coastal and dune bordering, we cite the suitability of environmental conditions in Wadi Jīzān for the cultivation of certain plants that are used to "remove heavy metals using its microbial system. These natural chelations, to put back into circulation the heavy metals stored in the soil, are done gently over a long period of time through plants, such as crucifers, which can produce chelating compounds, capable to absorb heavy metals and transform them into new metals and vitamins. It is also possible to follow a physical treatment based on activated carbon as a universal antidote or bentonite and montmorillonite to chelate and detoxify heavy metals and reuse them for industrial purposes (Vandezeghe, 2022).

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References

- Abdelkarim, A. (2019). Flood Hazards of the Jizan-Abha Highway, Kingdom of Saudi Arabia by Integrating Spatial-Based Hydrologic and Hydrodynamic Modeling. *Global Journal of Engineering Science and Research Management*, 19(4), 92. <https://doi.org/10.3390/s19051024>
- Abdel Wahab A, Abul Maaty M.A, Stuart. F, Awad. H, Kafafy, A. (2014). The geology and geochronology of Al Wahbah maar crater, Harrat Kishb, Saudi Arabia, *Quaternary Geochronology* 21 (2014) 70-76, <http://dx.doi.org/10.1016/j.quageo.2013.01.008>
- Al-Boghdady, H. (2019). Chemical analysis and environmental impact of heavy metals in soil of Wadi Jazan area, southwest of Saudi Arabia, *Applied Ecology and Environmental Research* 17(3): 7067-7084, DOI: http://dx.doi.org/10.15666/aeer/1703_70677084
- Al-Sulbi, A.O. (2010). Potentialities planning of sustainable ecotourism in the Kingdom of Saudi Arabia, *Sustainable Tourism IV, On Ecology and the Environment*, Vol 139, pp 20-214. doi:10.2495/ST100181
- Algahtany, H. (2000). Southwest Arabia: The privacy of the place and the building of biodiversity and climate in Asir. *AL-HAYAT*, 13597.
- ALMamony, M. (2015). KSA offers diversity in domestic tourism. *Saudi Gazet*.
- Al Sliman, F., Qahtani. S., Adini .M, Zahrani. R. (2021). Economic and social profiles of tourists in the coastal region of Asir, *Humanities and Educational Sciences Journal*, Vol 7; N 16, pp 137-164.
- Al Sliman, F. (2017). towards the development of sustainable tourism using GIS and remote sensing, *Journal or King Khalid University for Humanities Sciences*, Vol 3; N 13, pp 97-142.
- Azaiez, N., Zoughlami, K., Baazaoui, N. (2022). Comportement hydrologique des bassins versants aménagés en terrasses agricoles : exemple du bassin versant Khat-Khatabah : région d'El Majardah et ses abords, *International Journal of Innovation Scientific Research and Review*, Vol. 04, Issue, 05, pp.2736-2745.
- Azaiez, N. & Allaoua, A (2022). Le risque d'inondation dans le quartier d'El Mensek: de l'aléa morpho-hydro-météorologique au risque résiduel d'ordre socio-naturel (Abha, Arabie Saoudite), *Algerian Journal of Engineering Architecture and Urbanism* Vol. 6 Nr. 4 2021 ISSN: 2588-1760, <https://www.aneau.org/ajeau/>
- Allaoua, A & Azaiez, N. (2021). Mapping of Flood Zones in Urban Areas through a Hydro-climatic Approach: The Case of the City of Abha, *Earth Science Research*; Vol. 10, No. 2; pp doi:10.5539/esr.v10n2p1.
- Aronson, R.B. & Precht W.F. (1995). Landscape patterns of reef coral diversity: a test of the intermediate disturbance hypothesis. *J. Exp. Mar. Biol. Ecol.*, 1992, 1-14 DOI : [10.1016/0022-0981\(95\)00052-S](https://doi.org/10.1016/0022-0981(95)00052-S)
- Barabé, A. (2013). Tourisme et développement durable : état de situation et perspectives d'avenir, Volume 18, 1995 - Issue 2, Pages 395-414, <https://doi.org/10.1080/07053436.1995.10715506>
- Blangy, S. (1993). *Tourisme et environnement : du tourisme de nature à l'écotourisme*, Cahiers Espaces. Paris: Éditions Touristiques Européennes.
- Boo, E. 1990. *Ecotourism: The Potentials and Pitfalls*. Vol. 1, Washington, D.C.: World Wildlife Fund with the support of the U.S. Agency for International Development.

- Besancenot, J.P. (1990). Climat et tourisme. Masson, collection Géographie, 223p.
- Chancerelle, Y. (1996). Caractérisation des paysages récifaux sous-marins de l'île de Moorea (Polynésie française). Thèse, Univ. Pacifique, 165 pp.
- Christian, R., Voolstra, Michael L., Berumen, (2019). Coral Reefs of the Red Sea, Springer Cham, pp IX, 179, <https://doi.org/10.1007/978-3-030-05802-9>.
- Daligaux, J. (2003). Urbanisation et environnement sur les littoraux : une analyse spatiale. Rives nord méditerranéennes, (15) : 11-20. <http://rives.revues.org/12#quotation>.
- De Freitas, C.R. (2003). Tourism climatology: evaluating environmental information for decision making and business planning in the recreation and tourism sector. Int J Biometeorol 48:45-54.
- De Freitas, C.R., Scott, D., McBoyle, G. (2005). Specification and verification of a new generation climate index for tourism. Ann Meteorol 41:600-603.
- Dodge, R.E. (1978). The natural growth records of reef buildings corals. Ph. D. Thesis Yale University, 237 pp.
- Dodge, R.E., Turekian K.K., Etvaisnys J.R. (1977). Climatic implications of Barbados coral growth. Proc. 3rd Int. Coral Reef Symp., 2, 361-365.
- Données mondiales, (2023). <https://www.donneesmondiales.com/asia/arabie-saoudite/tourisme.php>.
- Gomez-Martin, B. (2006). Climate potential and tourist demand in Catalonia (Spain) during the summer season. Climate Research, 32, 75-87. Harlfinger O., 1991: Holiday biometeorology: a study of Palma de Majorca, Spain. GeoJournal, 25, 377-381
- Goreau, T.J. (1977). Seasonal variations of trace metals and stable isotopes in coral skeletons: physiological and environmental Controls. Proc. 3rd Int. Coral Reef Symp., 2, 425-430.
- Heiss, G.A. (1994). Coral reefs in the Red Sea: growth, production, and stable isotopes. *Geomar report*, 32, 141 pp.
- Hénia L. & Alouane, T. (2007). Le potentiel climato-touristique de la Tunisie. Publications de l'Association Internationale de Climatologie, 20, 27-33.
- Hamilton, J.M., Maddison, D.J., Tol, R.S.J. (2005). Climate change and international tourism: A simulation study. Global Environmental Change 15 :253-266.
- Inskeep, EDW. (1991). Tourism Planning: An Integrated and Sustainable Development Approach 1st Edition, Wiley, pp 528.
- Iwan Le Berre, LETG, UMR6554 CNRS, IUEM-UBO. (2020). L'artificialisation des littoraux : déterminants et impacts, Article rédigé dans le cadre de l'Expertise collective (ESCO) IFSTTAR, INRA sur l'artificialisation des sols : <http://institut.inra.fr/Missions/Eclairer-les-decisions/Expertises/Toutes-les-actualites/Sols-artificialises-etprocessus-d-artificialisation-des-sols>
- Kahal, A., El-Sorogy, A.S., Qaysi, S., Almadani, S., Kassem, O.M., Al-Dossari, A. (2020). Contamination and ecological risk assessment of the Red Sea coastal sediments, southwest Saudi Arabia. Mar. Pollut. Bull. 154. <https://doi.org/10.1016/j.marpolbul.2020.111125>
- Kraus, N.C. (1988). The Effects of Seawalls on the Beach: An Extended Literature Review. Journal of Coastal Research, Special Issue (N°4: The Effects of Seawalls on the Beach): 1-28. <http://www.jstor.org/stable/25735349>
- Kuété, M., Assongmo, T. (2002). Développement contre Environnement sous les Tropiques : l'exemple du littoral de la région de Kribi (Cameroun). Les Cahiers d'Outre-Mer, 55 (219): 279-306. <http://dx.doi.org/10.4000/com.1003>
- Martínez, M.L., Intralawan, A., Vázquez, G., Pérez-Maqueo, O., Sutton, P., Landgrave, R. (2007). The coasts of our world: Ecological, economic, and social importance. Ecological Economics, 63 (2-3): 254- 272. <http://dx.doi.org/10.1016/j.ecolecon.2006.10.022>

- Matzarakis, A. (2007). Assessment method for climate and tourism based on daily data. *Developments in Tourism Climatology*.
- Morgan, R., Bursalioglu, B., Hapoglu-Balas, L., Jones, T. C., Ozhan, E., Williams, A. T. (1995). Beach user opinions and beach ratings: A pilot study on the Turkish Aegean Coast. In E. Ozhan (Ed.), *Medcoast 95* (pp. 373-383). Ankara, Tur.
- Mieczkowski, Z. (1985). The tourism climatic index: a method of evaluating world climates for tourism. *Can Geogr* 29(3) :220-233
- Moufti, M.R & Németh K. (2016). *Geoheritage of Volcanic Harrats in Saudi Arabia, Geoheritage, Geoparks and Geotourism*, Springer International Publishing Switzerland 2016, 205p.
- Nakhli, S. (2010). Pressions environnementales et nouvelles stratégies de gestion sur le littoral marocain. *Méditerranée*, (115) : 31-42. <http://dx.doi.org/10.4000/mediterranee.4996>
- Paskoff, R. (2010). *Les littoraux : impact des aménagements sur leur évolution*. Paris : A. Colin.
- Pinot, J.-P. (1998). *La gestion du littoral*. Paris : Institut océanographique.
- Seddon, P.J. & Khoja, A.R. (2003). Saudi Arabian tourism patterns and attitudes. *Annals of Tourism Research*, 30(4), 957-959.
- Seddon, PH and Khoja, A.R, (2003). Youth Attitudes to Wildlife, Protected Areas and Outdoor Recreation in the Kingdom of Saudi Arabia, *Journal of Ecotourism*, 2:1, 67-75, DOI: 10.1080/14724040308668134
- Som, A.P.M. & Al-Kassem, A.H. (2013). Domestic tourism development in Asir region, Saudi Arabia. *Journal of Tourism & Hospitality*, 2167-0269
- Suratman, M. N. (2008). Carbon sequestration potential of mangroves in southeast Asia. *Managing Forest Ecosystems*, 297–315 doi:10.1007/978-1
- Vandezeghe, S. (2022). Éliminer les métaux lourds de l'organisme par des approches naturelles, Doctonat, L'encyclopédie de référence des médecines naturelles. <https://doctonat.com/eliminer-metaux-lourds-naturellement/>
- Van, S. N., & Viet, B. N. (2019). Factors Effect on Tourist Loyalty: A Case Study of Homestay Tourism in Ben Tre (Southern Vietnam). *African Journal of Hospitality, Tourism and Leisure*.