

TRANSPORT CONNECTIVITY OF REMOTE ISLANDS: THE CASE OF KASTELLORIZO, GREECE

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ABSTRACT

This paper examines the transportation network and connections of the eastern Greek island, Kastellorizo. The major factors related to the island's connectivity have to do with its remote location, the existing transportation infrastructure and the economic and political conditions. Kastellorizo faces significant challenges the most important of which is the insufficiency of the existing infrastructure to satisfy a potential increase in transportation volumes. Specific solutions are suggested for the upgrading of the island's transportation linkages. These include ideas for increasing the local transportation demand, promoting the island's natural beauty, introducing sustainable tourism practices and offering incentives to transportation providers to include Kastellorizo in their routes. The importance of the transportation infrastructure and sustainability for the residents is highlighted in this paper's conclusions. Future research is needed to further explore the transportation challenges that remote islands face and recommend targeted solutions taking into account the unique characteristics of the regions in question.

KEYWORDS

Connectivity; remote islands; air transport; sea transport; Kastellorizo

1. INTRODUCTION

Remote areas due to their geographical distance from metropolitan areas are heavily dependent upon transportation services for the greater part of their everyday life needs (Pungetti, 2012). Remote communities quite often find it difficult to access important services because of the inadequate transportation infrastructure, which could result in worsening their well being. Transportation linkages and the respective networks of all types could play a critical role for the economic and tourism development of such areas (Agius et al., 2020). In most of the cases of remote regions, both island and mainland, the development of a sound transportation network could be the main driver behind a possible significant improvement of private and public aspect of locals' routine. In most cases of remote regions, especially during difficult meteorological periods of the year, the transportation network and the available means of transport play a significant role in facing several types of emergency incidents. Overall, transportation networks and connections are essential for the endurance and development of remote communities (Castanho et al., 2021).

Kastellorizo is a small remote Greek island of the eastern Aegean Sea, near the coast of Turkey (Figure 1). The population is slightly more than 500 (2021 population census) with the ferry services being the most common mode of transportation to and from the island connecting Kastellorizo with the nearby islands of Rhodes and Kos and the Greek major port of Piraeus. There are also seasonal ferry services to the island of Samos and the Turkish port of Kaş. The island is also being served by a small airport connecting Kastellorizo with Rhodes and Athens but these flights are not daily. Sea taxis are also available but the frequency of the services provided is rather limited. Kastellorizo is also connected to the small neighbouring island of Ro by a daily scheduled boat service.

This paper that presents an assessment of how the remote geographical position of Kastellorizo and the existing transportation linkages impede the accessibility and mobility of residents and visitors is divided into five sections. After the introduction comes section two which provides a brief review of relevant literature. Section three explains the empirical methodology applied which is based on data descriptive analysis while section four combines the results of the study and the discussion part of this research commenting on the significant challenges Kastellorizo faces in transportation connectivity. The paper concludes by briefly presenting the conclusions and providing recommendations for future research.

Figure 1. Map of Kastellorizo



Source: Wikipedia

2. LITERATURE REVIEW

2.1 Remote islands' connectivity

Previous research on transportation networks and connections in remote island areas has focused on several key themes including the challenges and limitations of transportation infrastructure and the economic and social impacts of transportation access (Button and Taylor, 2000; Brueckner, 2003; Percoco, 2010; Arvis and Shepard, 2011; Bilotkach, 2015; Albalade and Fageda, 2016) and the potential for sustainable transportation solutions.

One major challenge faced by remote island areas is the lack of infrastructure and connectivity to mainland transportation networks (Cross, 1996). This can make it difficult for residents and visitors to access essential goods and services (Surya, 2015) and can also limit economic development opportunities (Andriotis, 2004; Baker, Merkert, & Kamruzzaman, 2015). The inefficiency of the transportation network and infrastructure has been proven a crucial negative factor on the overall well-being of the residents of remote regions (Karampela et al., 2014; Asian Development Bank, 2012) mainly because of the limited access to healthcare services (EC, 2022; Kavrouidakis and Penteridou, 2017) and other services that are considered important for their everyday life. Another key theme in previous research on transportation networks and connections in remote island areas is the economic and social impacts of transportation access (Hilvano et al., 2022). It has been observed in most cases that initiatives related to significant infrastructure upgrading were among the most important reasons for increased economic activity and employment (World Bank, 2018) together with better education and healthcare options. However, increased transportation mobility, in some cases where development schemes were realized without proper awareness, there were negative impacts on the environment. Research has revealed that implementing sustainable transportation options should not only be financially viable and beneficial for the environment

but also enhance the well-being of people living on islands (Cross & Nutley, 1999; Forni & Bennett, 2017).

Overall, previous research on transportation issues directed related to remote island regions has proved important the need for efficient, restructured and sustainable transportation infrastructure and networks for the economic and social prosperity of the residents (EC, 2022).

2.2. Challenges and barriers to transportation in remote areas

Transportation in remote island areas can pose several challenges and barriers including geography (Spilanis, Kezos, & Petsiote, 2012; Sunarti, 2018), limited resources, weather, (Mendas, 2015), limited connectivity, environmental and political concerns. The isolation and the complicatedness to access remote island regions are considered two of the most important reasons behind the complexity and the lack of determination to build and preserve the transportation infrastructure needed (Makkonen et al, 2013). Remote island communities often have limited resources, both financial and human, which can make it difficult to invest in transportation infrastructure and maintain it. The intense weather conditions that many of the remote island regions deal with can cause severe damage to the transportation infrastructure and make access to the island even more difficult than it already is (Forni & Bennett, 2017). The population of such remote regions usually have limited access to the decision centres making even more difficult for them to put significant pressure upon decisions that concern better transportation infrastructure and increased funding. Transportation services for remote islands could be a continuous challenge that can be mainly dealt with functioning infrastructure initiatives that could help minimize the interruptions of the transportation activity (Zenelis et al., 2011).

3. METHODOLOGY

Purpose of this paper is to study the connectivity status of Kastellorizo through the existing transportation options to and from the remote island in question. Through the analysis of transport itineraries and schedules, travel timetables and several other relevant data sources, we try to examine the accessibility conditions that the locals and the visitors of Kastellorizo are facing. Through this analysis we aim to shed light on the implications of isolation on connectivity and mobility and to identify potential solutions to improve transportation to and from Kastellorizo.

In this paper that has to do with the transportation connection of Kastellorizo the main method that was used to gather and analyze data was data collection through different databases and sites directly or indirectly related to the field in question. To gather data on transportation connections of Kastellorizo various databases were accessed including the Hellenic Statistical Authority, the Hellenic Civil Aviation Authority, the Bank of Greece and the Institute of SETE. The data collected had to do with information on transportation infrastructure, transportation services and passenger traffic in Kastellorizo. The research of this paper was based upon a combination of data collection through databases and application of various analysis techniques so as to provide a comprehensive understanding of the transportation connections and identify any potential areas for improvement concerning the connectivity of the remote island of Kastellorizo.

4. RESULTS AND DISCUSSION

Because of the fact that Kastellorizo is one of Greece's remotest locations, transport connectivity to and from the island is a constant challenge despite the seasonal positive fluctuations. Some of the major factors that influence transport connectivity to Kastellorizo include its geographical location, the availability of adequate transportation infrastructure and the economic and political conditions.

The island of Kastellorizo is the easternmost island of Greece, a remote location that makes it difficult for transportation companies to reach the island regularly while the island's small population makes it less profitable for transportation companies to include relevant regular services in their business and operational plans.

Table 1 includes information on the locations that have regular air or sea connections to the island of Kastellorizo including the straight-line distance from Kastellorizo, the frequency of air or sea connections per week during low and high seasons and the average duration of the journeys.

Table 1. Distance, connection frequency and average journey duration of three destinations that are connected to Kastellorizo.

City / Port	Distance (in km)	Flights per week (low/high season)	Duration of flight (net)	Ferry journeys per week (low/high season) ¹	Duration of trip
Athens, Greece	560	3 / 4	1hr 40min ²	2 / 2	>20 hrs
Rhodes, Greece	125	3 / 4 ³	40min	2 ⁴ / 6	2 - 5 hrs ⁵
Kaş, Turkey	8	∅	∅	7 / 7	20 min

Source: Olympic Air, Google maps and Ferryscanner. Data processed by the author.

According to the information presented in Table 1, the travel options between Athens and Kastellorizo are limited with ferry trips taking almost a day. The number of flights and the low-season ferry journeys per week between Kastellorizo and Rhodes are close to the respective figures of the Athens – Kastellorizo air and sea travel options since the vast majority of the flights and ferry journeys between the two destinations includes a stopover at Rhodes. The geographical position of the island of Kastellorizo is the main reason behind the numerous ferry connections to Kaş, Turkey, throughout the year because of its proximity to the island.

The remote location of Kastellorizo is the main reason behind the struggle of the island with enduring limited transport connectivity phenomena. Apart from the island's "marginalized" location, the insufficiency of adequate infrastructure such as a contemporary airport and harbor capable of meeting modern transportation requirements further aggravates the abovementioned situation.

The dock, which is situated in Megisti Bay, home to the main village, has a length of 82m and a useful depth of 6,30m (MPFSD, 2022). It caters to ferries, cruise ships and catamarans visiting the island. The current condition of the port infrastructure necessitates interventions aimed at enhancing the overall serviceability and safety of shipping operations as well as increasing the volume and frequency of passenger traffic to the island of Kastellorizo while also promoting more evenly distributed visitors' volumes throughout the year. Additionally, there should be initiatives to make the port operationally more secure, preserve and protect the environment and safeguard the ecosystem from pollution, contamination, and destructive human interventions.

¹ Changes in schedules/frequency due to weather conditions may occur.

² The flight itinerary includes a stopover in Rhodes and only itineraries with a stopover duration of less than 5 hours have been considered.

³ The frequency of flights between Athens and Kastellorizo, as well as between Rhodes and Kastellorizo, is congruent as a result of the established flight itinerary structure between Athens and Kastellorizo, which incorporates a layover in Rhodes.

⁴ The ferry journey from Piraeus to Kastellorizo includes a stop in Rhodes.

⁵ The duration of the journeys depends on the type of boat (ferry or high-speed ship).

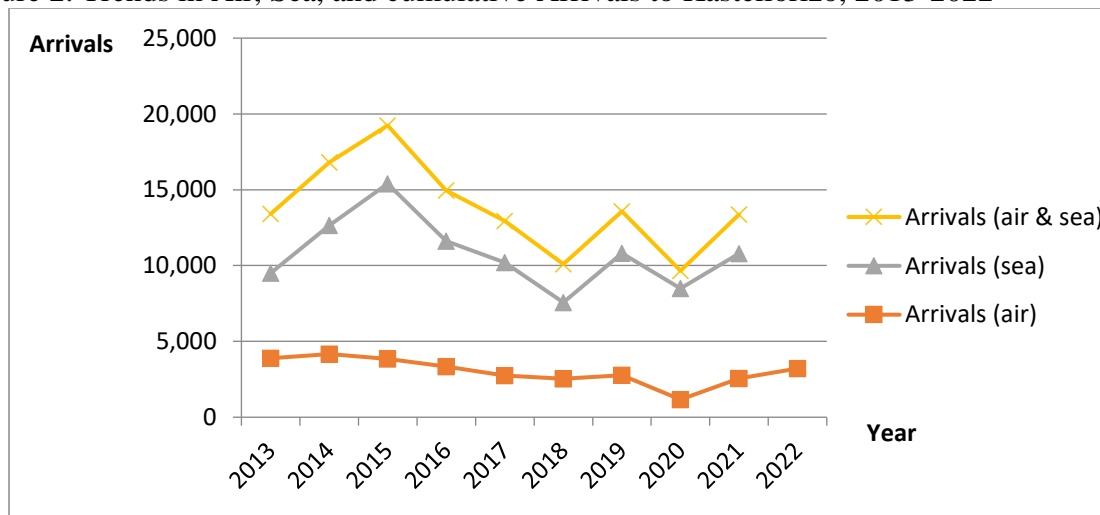
The Municipal Airport of Kastellorizo which has been in operation since 1986 is situated four kilometers from the port of Megisti. It works as an airport for domestic flights with only one passenger terminal, four parking spaces for aircraft and is exclusively designed to accommodate small aircraft with a maximum seating capacity of 20 passengers. The airport's runway has a length of 798m and 25m in width while the terminal building is 150m². The Civil Aviation Authority which is responsible for the management of the airport is planning to extend the runway by 250m together with an increase in its width by 30m. There are also plans for the construction of a new passenger building of 500m² so as to achieve the airport's overall operations and activities improvement (HCCA, 2023).

The limited capacity for simultaneous aircraft operations and the lack of sufficient infrastructure to support medium and large aircraft at the Kastellorizo airport are major obstacles to increasing tourist traffic, particularly in light of the prolonged travel time via ferries as an alternative mode of transportation to the island.

The economic crisis that Greece was facing during the second decade of the 21st century caused significant setbacks to the island's infrastructure development plans and the quality upgrading of the island's transportation services. One of the primary ways in which the economic downturn has affected transportation on Kastellorizo is through decreased funding for infrastructure projects. The Greek government, through the memoranda reforms that were decided to be incorporated in the national budget's implementations, tried to improve the economy's performance but the agreed public expenses cutting included reduced investments in transportation infrastructure.

The COVID-19 pandemic has had a significant impact on the economy of the island of Kastellorizo. It has greatly impacted the air and ferry transportation service to and from the island of Kastellorizo in several ways, a situation that directly affected both the locals and the visitors.

Figure 2. Trends in Air, Sea, and cumulative Arrivals to Kastellorizo, 2013-2022⁶



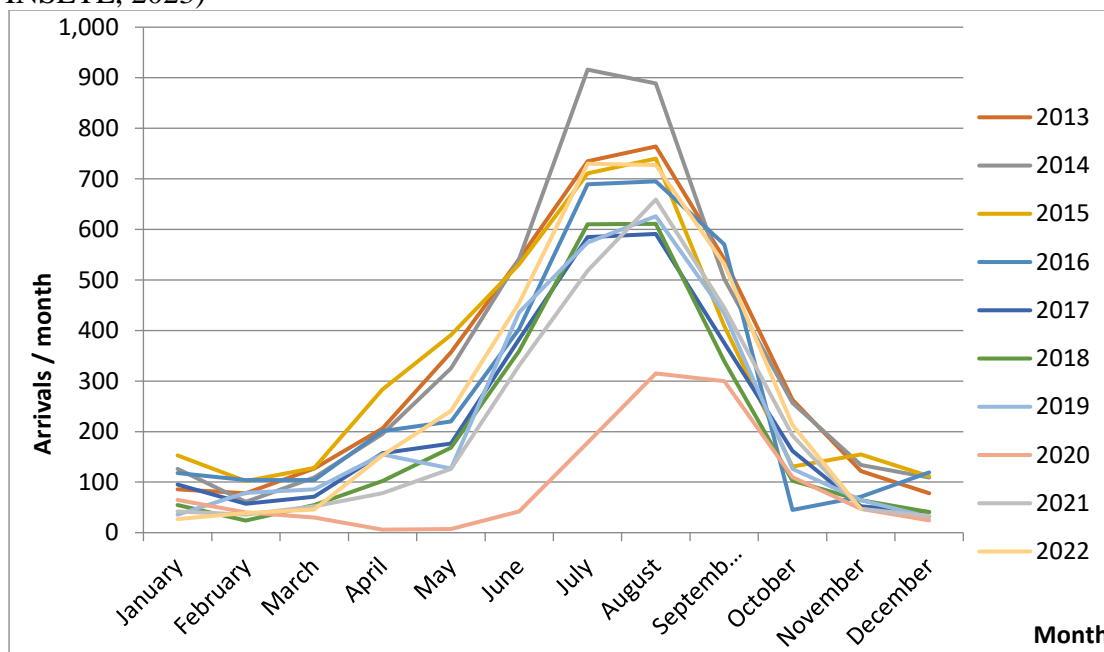
Source: Bank of Greece, 2023; INSETE, 2023. Data processed by the author.

The arrivals volumes varied over the last 10 years though there is a slight increase trend after the Covid-19 pandemic and the relaxation of the lockdown measures (Figure 2). This increase is observed at the air, sea, and air and sea combined categories. The arrivals by air

⁶ At the time of writing this paper, no data had been published regarding the number of visitors arriving by sea on the island of Kastellorizo in 2022 while the data for the 2022 arrivals by air refers to the period Jan – Nov 2022

were almost four thousand in 2013 while the respective arrivals by sea were almost ten thousand. The combined number of arrivals was almost fourteen thousand. The shares' trend presented above continued over the next couple of years despite the increased number of arrivals with a peak in 2015 with almost twenty thousand combined arrivals. During the following two years, the arrivals by sea also decreased, with 11.607 (2016) and 10.199 (2017) arrivals. As a result, the combined number of arrivals also decreased in these years. The trend of fluctuations in the number of arrivals continued in 2018 and 2019, with the combined number of arrivals being 10.101 and 13.583 respectively. In 2020, there was a significant decrease in the number of arrivals due to the COVID-19 pandemic with only 1.164 arrivals by air and 8.492 arrivals by sea. The combined number of arrivals was 9.656. After the initial year of the pandemic breakout (2021) there was a small increase in the number of arrivals both by air and sea. The combined number of arrivals was 13.359. Finally, in 2022, there was only data available for arrivals by air, with 3.208 arrivals for the period January to November (HAS, 2022; INSETE, 2022). The data presented above indicate that the number of arrivals to Kastellorizo has been fluctuating over the years with a slight increasing trend.

Figure 3. Seasonality of the Arrivals by air to Kastellorizo, 2013-2022⁷(Bank of Greece, 2023; INSETE, 2023)



Source: Bank of Greece, 2023; INSETE, 2023. Data processed by the author.

In Figure 3 is more than obvious that there is clear seasonality in the number of arrivals by air to Kastellorizo from 2013 to 2022 with higher numbers occurring during the summer months of June to August and lower numbers during the winter and early spring months of January to March. August was the busiest month of each single year during the last decade in terms of arrivals with an average of 662 arrivals while February on the contrary scored rather low for the same years with an average number of arrivals slightly higher than 60. Overall, the data highlights the importance of the summer season for the tourism industry in Kastellorizo with most of the arrivals occurring during the months of June to August, a phenomenon that remained unchanged in 2020 despite the extraordinary situation of the

⁷ The data for the 2022 arrivals by air refers to the period Jan – Nov 2022

pandemic. Understanding the seasonality of arrivals can help to inform the tourism industry and local businesses in planning and preparing for the peak tourism season.

The decreasing trend of the second half of the previous decade in air traffic to Kastellorizo and the current low volumes can be partially attributed to the necessity for a stopover in Rhodes and the transfer to a smaller aircraft for the second leg of the flight from Athens. This requirement results in increased inconvenience for travelers, as it necessitates additional time and resources. The limited availability of seats on the Athens to Rhodes leg of the flight mainly happens because of the high demand for travel to Rhodes because of diachronically being a popular tourist destination. This results in a scarcity of affordable seats for travellers with Kastellorizo as their final destination, thereby deterring potential travellers from opting for air travel to Kastellorizo and contributing to the low volumes of air arrivals.

The financial burden of accessing the island of Kastellorizo including the escalating expenses associated with fuel prices and ferry and air transportation fares, acted as a deterrent for prospective tourists over the past few years. The increased inflation that continuously puts pressure upon the cost of fuel affects the total cost for both ferry and air transport services. As a result of the significant increase in fuel prices the transportation cost also increased making it more expensive for visitors to travel to Kastellorizo (Hope, 2008). Another factor contributing to high transportation costs is the limited options available, as a lack of competition in ferry and air transport services results in higher ticket prices (Papatheodorou & Zenelis, 2013). The limited number of arrivals to Kastellorizo led to an increase in transportation costs since the overall cost of the transportation services had to be spread over lower passenger load factors. The Public Service Obligation (PSO) subsidy scheme that was put in place by governments to support air transport services to remote or underserved areas, that is the case of the Rhodes - Kastellorizo flights, was intended to help keep ticket prices affordable for residents and visitors to the island. However, despite the implementation of this scheme the cost of air transport tickets remained high mainly because of the limited number of flights available together with the long distance of Kastellorizo from the major ports of the mainland.

The political factors that influence the transport connectivity of Kastellorizo include the island's location in the Eastern Mediterranean which has led to tension and disputes between Greece and Turkey over maritime borders and territory. This may have caused insecurity feelings among potential visitors resulting in decreased demand for transportation services. On the other hand the island's status as a European Union member state's territory has attracted European funds such as the PSO scheme and funding for improvement initiatives for transportation infrastructure and services. However, the island's small population and remote location could be a reason for making it a low priority for the government to invest in Kastellorizo's transportation infrastructure upgrading.

The meteorological conditions in the Eastern Mediterranean where Kastellorizo is situated, especially in the autumn-winter months, are determined by increased wind velocity and high seas, conditions that quite often impede the transportation network's scheduled operation and services' unobstructed frequency.

4.1. Limited infrastructure and travel challenges affect Kastellorizo's accessibility

The limited capacity for aircraft operations and the lack of adequate infrastructure to support medium and large aircraft at the Kastellorizo airport are considered to be the major obstacles to satisfying increased tourist traffic given the prolonged travel time via ferries as an alternative way to access the island. Kastellorizo's main dock which is situated in Megisti Bay does not meet modern transportation prerequisites and needs significant upgrade so as to provide serviceability and safety for shipping operations.

The arrivals volumes at Kastellorizo reveal that there has been a fluctuating trend over the years. According to the data available August was the busiest month for Kastellorizo while

June and July also score high compared to the rest of the year. Furthermore, there was a significant decrease in 2020 due to the COVID-19 pandemic. Low volumes in the air traffic to Kastellorizo are partially attributed to the itineraries' structure which includes a stopover in Rhodes and the transfer to a smaller aircraft a situation that results in increased inconvenience for travelers. The limited number of seats on the Athens-Rhodes leg of the flight can be attributed to the high demand for travel to Rhodes which has as a result increased fares and low volumes of air arrivals to Kastellorizo.

The economic downturn in Greece and the COVID-19 pandemic have had a significant impact on the island's transportation infrastructure and services. The insufficient and postponed funding for infrastructure projects and the travel restrictions imposed as a result of the pandemic outbreak have further shrunk travel to and from the island. The increased cost to get to the island which is heavily dependent on the rising expenses associated with fuel prices and transportation viability acted as a disincentive for prospective visitors.

4.2. Kastellorizo's potential for development through a combination of sustainable tourism and improved connectivity

An increase of the demand for transportation services to and from the island of Kastellorizo could trigger connectivity upgrading for the island, a positive outcome that could be materialized through more regular and consistent transportation services, a conclusion that is in line with Angelopoulos et al. (2013). Significant demand growth could also stir up the improvement of the existing infrastructure such as the island's main port and the municipal airport, an argument that is consistent with the European Strategy for the Outermost Regions (EC, 2022).

The diverse and unspoiled natural landscapes of Kastellorizo have boosted dynamics for the attraction of a significant number of visitors. Natural beauty marketing campaigns and social media can be utilized to attract to Kastellorizo visitors seeking peaceful and remote holidays, as argued by Hays et al. (2012). Furthermore, personalized activities can be offered to attract visitors (Buhalis & Aditya, 2015) such as guided walks, snorkeling and diving lessons to explore the island's marine life.

Eco-friendly accommodations that do not harm the island's natural environment such as sustainable hotels and rooms could boost volumes of environmentally conscious travelers. This is also supported by past findings on green consumer behaviour (Kim et al., 2021; Rahman & Reynolds, 2019). By promoting their products and services to tourists and encouraging their active participation in traditional projects local businesses could create a sense of social contribution among the island residents and visitors. Sharing photos and travel information of the island through social media could also create additional demand for including Kastellorizo in holiday itineraries. Developing and implementing sustainable policies related to the tourism activity is considered to be rather important in attracting several different types of tourists (Grilli et al., 2021). This could be accomplished primarily by developing environment protection initiatives and informing visitors about the island's environment and the need to be preserved.

Kastellorizo could also become a short-break destination for people living or visiting the neighbouring islands. The most common practices towards achieving this hybrid tourism activity, among others, could be a) by offering discounted rates in several services for groups or families and b) by creating package deals that include transportation, accommodation and leisure activities on the island (Murphy et al., 2010). Kastellorizo could also host special events/themed weekends to attract visitors, develop an initiative where current excursion guests can refer friends and family for discounts on their next trip and offer a loyalty program where frequent visitors can earn rewards. The island of Kastellorizo could launch a social media campaign highlighting the unique characteristics and activities available, collaborate

with influencers or travel bloggers to include places at Kastellorizo on their platforms and offer special deals for last-minute bookings.

A way to increase the frequency of transport services to Kastellorizo would be to provide incentives to private transport companies to include Kastellorizo in their routes, an argument that is consistent with the results of the study of Malina et al. (2012). The development and implementation of economic incentives and discounts that could help the transport companies of the private sector to respond to the increased cost of providing transportation services to remote regions could be a way to start (Bråthen & Halpern, 2012). The introduction of measures could include subsidies or reliefs for fuel supplies and maintenance services and/or funding directly related to the purchase of new means of transportation. Another incentive would be to offer tax reliefs to private transport companies that include remote islands in their network such as reduced corporate tax rates or proportional exemptions from certain taxes. As illustrated in previous research (Currie & Falconer, 2014), public authorities in charge could also provide different types of support for the improvement of the existing infrastructure such as funding for the maintenance and/or upgrade of the existing port and airport. Sambracos (2001) has also studied the Greek insular market regarding the Air-Sea Transport and his results also indicated that one way to support the transport companies is by removing the regulatory burden they have to deal with by reducing the bureaucracy and the obligations that spring from the current polynomial regime. Lastly, giving priority access to private transport companies operating on remote islands for contracts and tenders for transportation services in the region, combined to other incentives granted, could contribute to an increase in the volumes of visitors accessing Kastellorizo.

5. CONCLUSIONS

This paper discusses the challenges the transportation services have to deal with in remote island areas specifically focusing on the island of Kastellorizo. The major challenges include geography (isolation and difficulty in accessing the destination in question), limited resources, severe weather conditions, limited connectivity to the mainland and environmental issues. Transportation connectivity of Kastellorizo is limited due to insufficient transportation infrastructure, limited air and sea connections and restricted capacity to handle simultaneous aircraft operations flying to the local airport. The economic downturn in Greece and the COVID-19 pandemic have further disturbed travel to and from the island by increasing financial burden and travel limitations for both tourists and locals. Therefore, the infrequent and limited transport services to and from Kastellorizo, facing additional constraints due to recent economic challenges and the COVID-19 pandemic, hamper the local economic growth and development and the social cohesion of the island.

Future research could focus on several key areas one of which could be the development of alternative transportation options such as seaplanes or helicopter services so as to improve the connectivity of the islands. The impact of increased tourism volumes on the transportation connectivity of Kastellorizo could also be studied including an analysis of the seasonality of the relevant demand (Zenelis & Papatheodorou, 2008) and capacity of the existing infrastructure. The possibility of developing renewable energy sources for the sea services to and from Kastellorizo combined to the development of charging stations for electric boats and yachts could also be a topic for further research. Last but not least, it could be interesting for the island connectivity prospects to examine different scenarios of more environmentally friendly transportation infrastructure and services that could significantly lessen carbon emissions and minimize the impact of leisure activities on the environment.

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