


AIRPORT INFRASTRUCTURE DEVELOPMENT: A COMPREHENSIVE IMPACT REVIEW

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ARTICLE INFO	<u>ABSTRACT</u>
<p>Article history:</p> <p>Received 17 October 2023</p> <p>Accepted 16 January 2024</p>	<p>Purpose: Airports play a vital role in global transportation networks, facilitating the movement of people, goods, and services, while also serving as catalysts for economic growth; however, it also has an environmental and social impact that needs to be analyzed. This literature review aims to address knowledge gaps concerning the influence of airport infrastructure on economic, socio-economic, environmental, and sustainability factors.</p> <p>Theoretical Framework: Adopts a multidisciplinary approach, blending economic, environmental, and societal theories of impact.</p> <p>Design/Methodology/Approach: The SPAR-4-SLR protocol was utilized, analyzing a comprehensive set of 32 scientific papers categorized within the previously mentioned areas.</p> <p>Findings: Several areas were identified that require further investigation, including strategies to mitigate the environmental impact of airports, assessment of socio-economic implications on local communities, and ensuring the long-term sustainability of airport operations.</p> <p>Originality/Value: Going beyond the conventional focus, the study provides original insights that extend the understanding of direct economic benefits, environmental consequences, and societal impacts. By synthesizing diverse perspectives, this research contributes significantly to the discourse on airport development, making it an invaluable resource for policymakers, industry stakeholders, and researchers.</p>
<p>Keywords:</p> <p>Airport Infrastructure; Airport Development; Impact; Economic; Social; Growth.</p> <div data-bbox="172 981 480 1227">  </div>	<p>Doi: https://doi.org/10.26668/businessreview/2024.v9i1.4166</p>

DESENVOLVIMENTO DA INFRAESTRUTURA AEROPORTUÁRIA: UMA ANÁLISE ABRANGENTE DO IMPACTO

RESUMO

Objetivo: Os aeroportos desempenham um papel vital nas redes de transporte mundiais, facilitando a circulação de pessoas, bens e serviços, ao mesmo tempo que servem de catalisadores para o crescimento econômico; no entanto, também têm um impacto ambiental e social que precisa de ser analisado. Esta revisão da literatura visa abordar as lacunas de conhecimento relativas à influência das infraestruturas aeroportuárias nos fatores econômicos, socioeconômicos, ambientais e de sustentabilidade.

Estrutura Teórica: Adota uma abordagem multidisciplinar, combinando teorias econômicas, ambientais e sociais de impacto.

Design/Metodologia/Abordagem: O protocolo SPAR-4-SLR foi utilizado, analisando um conjunto abrangente de 32 artigos científicos categorizados dentro das áreas mencionadas anteriormente.

Constatações: Foram identificadas várias áreas que requerem investigação mais aprofundada, incluindo estratégias para atenuar o impacto ambiental dos aeroportos, avaliação das implicações socioeconômicas para as comunidades locais e garantia da sustentabilidade a longo prazo das operações aeroportuárias.

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Originalidade/Valor: indo além do foco convencional, o estudo fornece percepções originais que estendem a compreensão de benefícios econômicos diretos, consequências ambientais e impactos sociais. Ao sintetizar várias perspectivas, esta investigação contribui significativamente para o discurso sobre o desenvolvimento aeroportuário, tornando-o num recurso inestimável para os decisores políticos, as partes interessadas do setor e os investigadores.

Palavras-chave: Infraestrutura Aeroportuária, Desenvolvimento Aeroportuário, Impacto, Econômico, Social, Crescimento.

DESARROLLO DE INFRAESTRUCTURA AEROPORTUARIA: UNA REVISIÓN DE IMPACTO INTEGRAL

RESUMEN

Propósito: Los aeropuertos desempeñan un papel vital en las redes mundiales de transporte, facilitando el movimiento de personas, bienes y servicios, a la vez que sirven como catalizadores para el crecimiento económico; sin embargo, también tiene un impacto ambiental y social que debe ser analizado. Esta revisión bibliográfica tiene como objetivo abordar las brechas de conocimiento sobre la influencia de la infraestructura aeroportuaria en factores económicos, socioeconómicos, ambientales y de sostenibilidad.

Marco Teórico: Adopta un enfoque multidisciplinario, combinando las teorías económicas, ambientales y sociales del impacto.

Diseño/Metodología/Enfoque: Se utilizó el protocolo SPAR-4-SLR, analizando un conjunto completo de 32 artículos científicos categorizados dentro de las áreas mencionadas anteriormente.

Conclusiones: Se identificaron varias áreas que requieren más investigación, incluyendo estrategias para mitigar el impacto ambiental de los aeropuertos, la evaluación de las implicaciones socioeconómicas en las comunidades locales y garantizar la sostenibilidad a largo plazo de las operaciones aeroportuarias.

Originalidad/Valor: Más allá del enfoque convencional, el estudio proporciona ideas originales que amplían la comprensión de los beneficios económicos directos, las consecuencias ambientales y los impactos sociales. Al sintetizar diversas perspectivas, esta investigación contribuye significativamente al discurso sobre el desarrollo aeroportuario, convirtiéndolo en un recurso invaluable para los responsables de las políticas, las partes interesadas de la industria y los investigadores.

Palabras clave: Infraestructura Aeroportuaria, Desarrollo Aeroportuario, Impacto, Económico, Social, Crecimiento.

INTRODUCTION

Airports are vital hubs in the global transport network, they facilitate the movement of people, goods, and services, connect communities and drive economic growth. The number of passengers registered in 2019, before the COVID-19 pandemic, reached a staggering number of 4,490 million (ICAO, 2021) and is expected to grow as much as 103% by 2024 (IATA, 2022). Moreover, in 2018, the aviation industry and its operations generated more than USD 2,7 trillion in the global GDP (ICAO, 2018). As a result, 915 million tons of carbon dioxide were produced in 2019 by the aviation industry, a number that in a regular scenario would be doubled by 2050 (Boshell, Kang, Gorini, & Kadir, 2022).

To address these concerns, the International Civil Aviation Organization (ICAO) has established a goal of achieving zero carbon emissions from aviation by 2050 (ICAO, 2022). Additionally, ICAO has allocated a budget of 21 million CAD (approximately USD 15,8 million) to accomplish its environmental protection strategic objectives between 2023 and 2025 (ICAO, 2022).

This literature review aims to identify knowledge gaps regarding the impact of airport infrastructure on economic and socio-economic factors, environmental aspects, and sustainability. By employing the SPAR-4-SLR protocol (Paul, Lim, O’Cass, Wei Hao, & Bresciani, 2021), a total of 27 scholarly research papers were selected for inclusion in this review. The results, conclusions, and findings of these papers were synthesized into four categories: economic impact, socio-economic impact, environmental impact, and sustainability, providing a foundation for further studies.

Looking ahead, the future research section of this paper will delve into the identified research gaps, highlighting areas that warrant further investigation. These include exploring new approaches to mitigate the environmental impact of airports (e.g., noise reduction strategies), assessing the socio-economic implications on local communities (e.g., tourism), and ensuring the long-term sustainability of airport operations (e.g., use of renewable energy sources). By addressing these gaps, the research community can make valuable contributions to the aviation industry's strategic objectives, foster sustainable airport development, and further enrich the scholarly discourse by synthesizing and organizing existing knowledge.

BACKGROUND

To better understand the context in which the review will be conducted the following concepts are presented. The four main pillars (economic impact, socio-economic, environmental, and sustainability) on which the review will be addressed. Additionally, theories are introduced to better understand the information presented further in the text.

Economic Impact

The term economic impact, when discussing airport infrastructure, refers to the consequences and effects the airport facilities have on local and national economies. Therefore, the total economic impact is the result of the sum of direct, indirect, and induced effects (Baker, Merkert, & Kamruzzaman, 2015). For example, direct effects are defined as employment and income generated by the airport (Song & Suh, 2022), and indirect and induced effects are defined as increased spending by tourists/visitors in the region and increased demand for goods and services (Baker, Merkert, & Kamruzzaman, 2015). Other authors also include catalytic impacts in their literature, this being "the role of airports as a driver of productivity growth and then as an attractor of new firms" (Bai & Wu, 2022). For the rapid economic growth at which they are induced.

Socio-Economic Impact

The term socio-economic impact, in this context, will be subject to the social and economic aspects airports have on society, having into consideration the implications for individuals and communities. It encompasses social well-being, quality of life, and the development of the community. People's perceptions of airport development projects are evaluated from a negative perspective using "The Negativity Bias theory" (Monterrubio, Andriotis, & Rodríguez-Muñoz, 2020). Furthermore, since airport infrastructure is a gateway to the development of tourism, the effects of such are evaluated by analyzing studies conducted in the German region (Doerr, Dorn, Gaebler, & Potrafke, 2020).

Environmental Impact

The term environmental impact, in this context, refers to the effects airport infrastructure has on the natural environment. Specifically, this paper will analyze research made on noise pollution and forms of mitigation when having airports near residential areas, health impact on people living in the proximities due to particulate matter when doing upgrades to airport infrastructure, and emissions reduction by the use of "green logistics" and "green initiatives" (Sokolova, Grygorak, & Ivannikova, 2022).

Airport Sustainability

The term sustainability, specifically when discussing airport sustainability, refers to ensuring long-term economic viability, and minimizing environmental impact, in this case through water management. In this context, the resilience of airport infrastructure when exposed to climate change, in events such as, increase of extreme weather, rising of sea levels, alterations in temperature and precipitation, and mechanisms to mitigate these threats like "green infrastructure" (Ferrulli, 2016) are also discussed. Furthermore, the importance of water management in airport operations, especially in water-scarce areas, is analyzed to ensure sustainable development and meet global regulatory frameworks (Dimitriou & Karagkouni, 2022).

MAIN THEORIES

Negativity Bias Theory

This theoretical perspective states that, "humans tend to give greater weight to negative situations rather than positive ones and that negative experiences play a more prominent role in overall evaluations of events" (Monterrubio, Andriotis, & Rodríguez-Muñoz, 2020). It is

mostly used in the field of psychology; hence, no previous researcher has utilized this theory to assess the significance of residents' negative perceptions regarding the impacts of tourism. This theory is further contextualized in the review to enhance our understanding of how residents perceive the development of the New Mexico City International Airport (NMCIA) and its implications on tourism. (Monterrubio, Andriotis, & Rodríguez-Muñoz, 2020).

Granger Causality Test

The Granger Causality test is a statistical hypothesis test used by researchers to seek correlations between forecastings (Rossi, 2013). This test is used to analyze empirical data gathered (Bai & Wu, 2022) and (Baker, Merkert, & Kamruzzaman, 2015).

Lancaster Demand Theory

The theory focuses on the individual consumer's decision-making process in choosing and allocating their limited income among various goods and services. Lancaster proposes that consumers derive utility directly from the characteristics or attributes of goods, rather than the goods themselves (Lancaster, 1966). Bimonte, Ferrilli, and Grilli use this framework to design their experiment on tourist preferences (Bimonte, Ferrini, & Grilli, 2014).

Sustainability Theory

The theory of sustainability, also known as sustainable development, is a concept that encompasses the balance between economic growth, environmental protection, and social well-being to meet the needs of the present generation without compromising the ability of future generations to meet their own needs (Brundtland, 1987). Authors use this theory to explain the concept of “sustainability, sustainable development, and sustainable airports” (Chourasia, Jha, & Dalei, 2020).

Green Airport Design Evaluation (GrADE) method

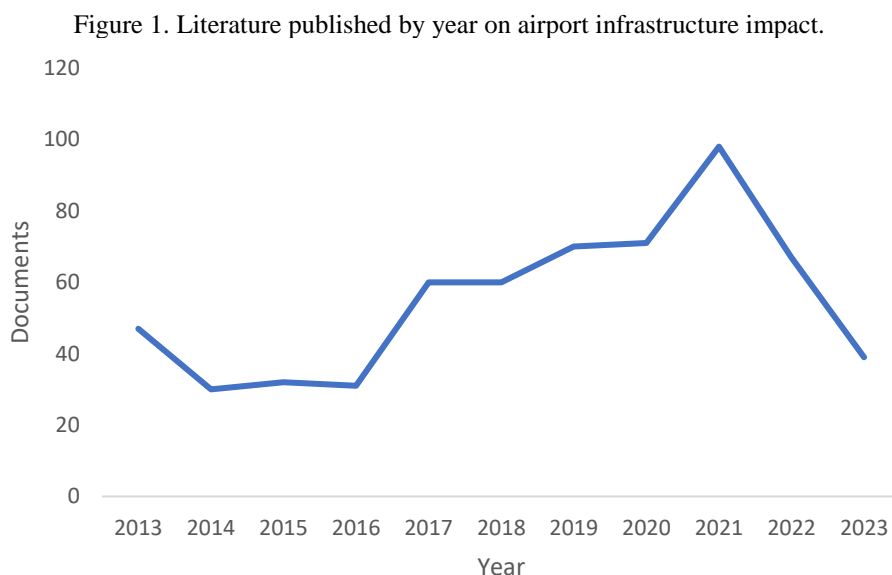
The Green Airport Design Evaluation (GrADE) method is a framework developed to assess and enhance the sustainability performance of airports. It provides a systematic approach for evaluating and managing the environmental impact of airport infrastructure development. The goal of GrADE is to promote sustainable development by considering all aspects that affect the project design decision process (Ferrulli, 2016). It was developed by author Paolina Ferrulli as part of her

doctoral research study that aimed to create a framework for assessing the sustainability performance of airport project design and is present in two papers included in this review.

Methodology

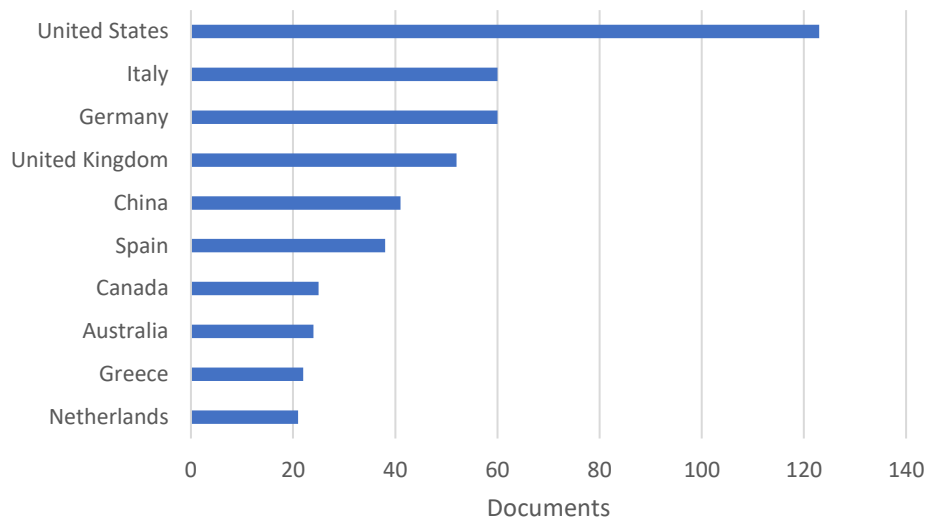
This study performs a systematic literature review to investigate the literature on the impacts of airport infrastructure developments to identify and evaluate current findings, identify gaps, draw conclusions, and provide future lines of research to mitigate negative impacts and enhance positive outcomes. It combines a domain-based structured review with a SPAR-4-SLR protocol (Paul, Lim, O’Cass, Wei Hao, & Bresciani, 2021) to identify research gaps. The SPAR-4-SLR protocol is divided into three stages: assembling (identification and acquisition of existing literature), arranging (organization and purification of the literature), and assessing (evaluation and reporting of the literature).

Figures 1 and 2 illustrate the progression of research papers published under the keywords "airport infrastructure" and "impact" over the years, a total of 613 documents. They provide insights into publications based on various factors such as country, document type, and prolific authors. A clear trend emerges from the data, showing a consistent increase in publications on the subject until the year 2021. However, there was a significant decline in 2022, and it appears that this downward trend may continue into 2023.



Source: Own elaboration Scopus (2023).

Figure 2. The number of documents published by country or territory.



Source: Own elaboration Scopus (2023).

Assembling

The initial phase of the SPAR-4-SLR includes two sub-stages: identification and acquisition of the existing literature. The identification stage focuses on the objective and source type of the review, which is to identify studies on the impact of airport infrastructure developments. Inclusion criteria included type of document (peer-reviewed research articles, conference papers, book chapters, and proceeding papers), language (English), type of article (qualitative and quantitative studies), type of impact (purely economic, socio-economic, environmental), and the year of publication (from 2013 to 2023).

Thereafter, during the stage of acquisition, it is imperative to implement a systematic search mechanism, stipulate a precise search window, carefully select relevant keywords, and record the total count of retrieved articles. The academic literature reviewed was obtained using The Web of Science Core Collection and Scopus databases. To ensure the relation of the papers to the topic, three groups of keywords related to the impact of airport infrastructure were used. The resulting equations were:

TITLE-ABS-KEY (airport AND infrastructure; AND development; AND impact)

This search string was applied to articles published between 2013 and 2023, yielding a total of 214 articles on Scopus, and 224 on Web of Science.

TITLE-ABS-KEY (airport; AND development; AND impact; AND infrastructure; AND economic; AND social)

This search string was applied to articles published between 2013 and 2023, yielding a total of 31 articles on Scopus, and 32 on Web of Science.

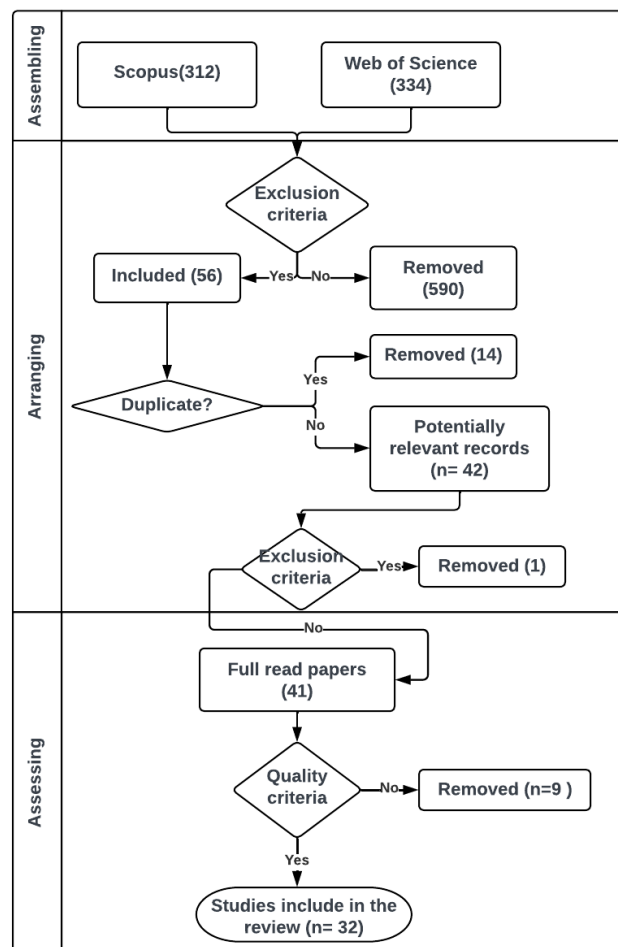
TITLE-ABS-KEY (airport AND development; AND airport AND infrastructure; AND impact; AND growth)

This search string was applied to articles published between 2013 and 2023, yielding a total of 67 articles on Scopus, and 78 on Web of Science.

Arranging

The second stage of the SPAR-4-SLR, namely the arranging stage, is composed of two sub-stages that involve the purification and organization of the study pool. During the purification stage, all studies underwent an assessment process to determine their suitability for inclusion or exclusion based on predetermined criteria. Articles titles and abstracts were reviewed, assigned appropriate parameters, and made decisions based on whether the studies met the criteria or not. The depicted procedure for paper selection, as shown in Figure 3, led to the establishment of a total of 32 primary articles.

Figure 3. Article selection process.



Source: Own elaboration, adapted from Paul et al. (2021).

Following that, in the organization substage, the resulting selected papers were divided for structuring. Fields such as author names, article title, source, volume, issue, starting page, ending page, article number, document type, year, and date of publication, abstract, times cited, author keywords, topic, variable, context, methodology, theory, and main results. Results can be found in Appendix.

Assessing

A framework was created for organizing the data from the 32 selected papers, which was analyzed using content and thematic analysis. Initially, the abstracts of each paper were the sole basis for reviewing impact variables (purely economic, socio-economic, environmental, and sustainability), topics, and results. Following that, the findings were summarized, and gaps in the research were identified, leading to the proposal of a research agenda for future endeavors. Figure 4 depicts the model on which the different topics were structured, analyzed, and discussed depending on the type of impact.

Figure 4. Structured model

<p style="text-align: center;">Purely Economic</p> <ul style="list-style-type: none"> • Impacts of regional air transport on regional economic growth. • Transportation infrastructure and its impact on economic development. • Economic development through airport infrastructure. 	<p style="text-align: center;">Socio-Economic</p> <ul style="list-style-type: none"> • The effects of the negative impact of airports in limitations to land usability and depreciation of their market value. • Effects of airports on societal resilience. • Impact of the airport development project on regional and local tourism. •
<p style="text-align: center;">Environmental</p> <ul style="list-style-type: none"> • Effect of airport facilities on population health. • Noise pollution of airports close to cities. • Environmental concerns on airports growth (noise and air quality) 	<p style="text-align: center;">Sustainability</p> <ul style="list-style-type: none"> • Sustainability in airport development projects. • Climate change and its effects on airport development planning • Airport sustainability

Source: Own elaboration.

Results

The final sample for analysis comprised 32 papers, with 50% published between 2020 and 2022, and the remaining 40% between 2013 and 2019. Table 1 below presents a summary of key aspects of the literature, including the percentage of papers within each category, the methodologies employed for data analysis, and the distribution of published papers across different years. A preliminary examination of the data reveals a notable emphasis by researchers in recent years on the economic and sustainability dimensions of airport infrastructure.

Table 1. Literature distribution

Category	Percentage	Methodology used			Publication year	
		Qualitative method	Quantitative method	Mixed method	2013-2019	2020-2022
Economic	30%	0%	63%	38%	30%	70%
Socio-economic	33%	44%	33%	22%	56%	44%
Environmental	15%	25%	50%	25%	86%	14%
Sustainability	22%	17%	50%	33%	33%	67%

Source: Own elaboration.

Purely Economic

Airports are a critical component of a nation's transportation infrastructure (Faghihinejad, Fard, Roshanghalb, & Beigi, 2022) and play a vital role in promoting economic growth and development (Song & Suh, 2022). Song and Suh note that their analysis demonstrates that perceptions of the regional benefit of airport development and operation have a close agreement with empirical evidence from previous studies. The outcome confirms the effect of airport operation and development on both regional development, and economic progress, and the general perception of the positive correlation between airport development and regional economic benefit (Song & Suh, 2022).

Furthermore, there is a long-term causality relationship between airport development and regional economic development (Bai & Wu, 2022). This has been found in Bai and Wu's study in Jiangsu Province in China. The study found that "the inter-contribution of GDP and airport development was sustainable and increasing over time. However, the impact of economic growth on airports was more significant than the impact of airports on economic growth". Meaning that, the contribution of aviation is not only about the airport itself but also about the "induced and catalytic impacts", such as "the funding of infrastructure and the attraction of new firms". The authors also stated that long-term strategic frameworks should be supported by governments to ensure investments decisions and "promote collaboration in provincial airports" (Bai & Wu, 2022). Studies on Senegal's' Blaise Diagne Airport further

show how airport construction positively affects GDP (Sipoaka & Cabral, 2021). In the same manner, Wong, Zhao, and Lee's statistical research findings across three macro-regions in China, indicate how airport infrastructures can catalyze regional economic development (Wong, Zhao, & Lee, 2022). Moreover, a study conducted between 2008 and 2017, in Turkish regions demonstrated a correlation between passenger volume and economic development. It was noted that through the implementation of deregulation policies in the aviation industry and strategic investments in transport infrastructure, Turkish governments successfully stimulated the growth of regional economies (Elburz, Nijkamp, & Pels, 2020).

Similarly, there is empirical evidence that the output effects of air transport differ significantly among airports (Allroggen & Malina, 2013). The study conducted in a German airport found that air transport connectivity has a significant impact on regional economic development, but the scale and direction of output effects differ among airports due to positive output effects from air transport connectivity and to "opportunity costs" of airport capital (Allroggen & Malina, 2013). Allroggen and Malina's research also suggests that expanding capacity-constrained airports could potentially stimulate economic growth if the positive effects resulting from increased air services outweigh the negative effects associated with capital investment. However, these impacts potentially depend on traffic characteristics. (Allroggen & Malina, 2013).

Direct, indirect, and induced contributions have received the majority of attention in studies examining the economic impact of airports (Baker, Merkert, & Kamruzzaman, 2015). However, more recently, recognition has focused on the catalytic effects, such as employment, and incomes resulting from aviation's influence on the tourism and trade industry (Baker, Merkert, & Kamruzzaman, 2015). The author's results indicate the importance of considering these causal relationships, particularly when assessing the role of airports in regional, rural, or remote communities. The causal relationship between air travel and economic growth shows that regional aviation has an impact on regional economies. Because of this, regional economic development strategies should focus on air transport, which will boost local industries such as tourism. In the same matter, the causal relationship between economic growth and air travel suggests that reducing subsidies to 'RRR' airports (regional, regional, and remote airports) is reasonable when the economy is strong without adversely affecting economic growth and should be increased when the economy is weak (Baker, Merkert, & Kamruzzaman, 2015). This suggests that air travel and economic growth are simultaneously determined and influenced. (Baker, Merkert, & Kamruzzaman, 2015).

On the other hand, studies conducted in airports in Slovakia demonstrated that even though small airports have improved their financial performance they still require subsidies to cover their operational costs, the question is whether the number of subsidies required can be justified from a taxpayer perspective and if these results could be representative of other countries (Kazdaa, Hromádka, & Mrekaj, 2017). The author's research shows that for the three airports studied, Piešťany, Žilina, and Poprad-Tatry, costs exceeded revenues by 2.460.000 euros, 2,310,000 euros, and 3,750,000 euros respectively (Kazdaa, Hromádka, & Mrekaj, 2017). This shows that there is a need for a better methodology to be developed to evaluate the economic impact of airports accurately, especially to help politicians in the decision-making process.

Table 2. Main studies about the economic impact

Year	Context	Main Results	Reference
2013	The study was conducted in 19 German airports.	The output effects of air transport vary significantly among airports due to factors such as capital appropriation and traffic characteristics. The study acknowledges the limitation of not directly capturing traffic patterns in their model and suggests incorporating information about traffic characteristics and transfer traffic in future research.	(Allroggen & Malina, 2013)
2015	The dataset spanned from 1985/86 to 2012/2013 in Australian airports.	Regional aviation and airports have causal relationships with economic growth. This relationship should be considered when planning and funding airports in regional communities. Financial support should be directed towards remote airports, and subsidies should be adjusted based on economic conditions.	(Baker, Merkert, & Kamruzzaman, 2015)
2017	The study was conducted on three subsidized airports in Slovakia.	Determining whether the indirect, induced, and catalytic impact of an airport on a region outweigh the cost of regional airport subsidies would contribute to informed regional development policy and decision-making.	(Kazdaa, Hromádka, & Mrekaj, 2017)
2020	The study conducted on Turkish airports	The deregulation of policies concerning the aviation industry and the heavy investment in transport infrastructure in Turkey have shown positive effects on the economy in all of their regions.	(Elburz, Nijkamp, & Pels, 2020)
2021	The dataset spanned from 2012 to 2018 from 29 countries.	Focusing on the quality of transport infrastructure, rather than just the quantity, has significant implications for the economic development of developing countries. Results suggest that governments should prioritize logistics reforms to increase trade opportunities at a lower cost and in less time.	(Sénquiz-Díaz, 2021)
2021	The study was conducted at the Blaise Diagne Airport in Senegal	The main conclusion of the paper is that while public investment in airport construction positively affects GDP, it negatively impacts foreign demand for tourism services. Reducing taxation on the fee for the development of airport infrastructure (RDIA) would stimulate the tourism sector and overall economic growth in Senegal.	(Sipoaka & Cabral, 2021)
2022	Access of 75 cities to the road transport network in Iran.	The results of the case study show that the access of cities to transportation networks strongly influences economic development and population size in Iran.	(Faghihinejad, Fard, Roshanghalb, & Beigi, 2022)
2022	Dataset spanning from 2005 to 2017 for 31 provinces grouped in three	Airports drive economic growth in countries and regions by increasing regional trade, job opportunities, urban development, and spatial spillover effects. However, air transport development can further deepen regional	(Wong, Zhao, & Lee, 2022)

	macro-regions (east, central, and west) in China.	inequalities and economic divergence. Public investment in air transport can have growth prospects but may also exacerbate income disparities	
2022	An online survey of 510 people in South Korea.	Regional development around airports is seen as advantageous for building consensus. Strategies should be developed to address negative effects and foster public confidence. The study provides insights and recommendations for promoting airport development based on social consensus.	(Song & Suh, 2022)
2022	The study was conducted in nine airports in Jiangsu, China.	The study emphasizes the need for long-term strategic spatial planning and closer collaboration among Jiangsu provincial airports, including aspects such as airline networks, flight schedules, and air service quality.	(Bai & Wu, 2022)

Source: Own elaboration.

Socio-Economic

Restrictions on the use of land that is near airports can have significant economic impacts on both the local and community levels. These restrictions can obstruct the development of local infrastructure and economic growth, which can lead to social losses (Foryś, Głuszak, & Konowalczyk, 2019). Indirect effects generated by airport operations can harm the value of the properties in limited-use areas, which can lead to a reluctance among owners to invest in their properties or even to maintain them properly. Evidence of this is a decline in property values and a decrease in economic activity in the affected areas. Social losses and obstruction of the development of local infrastructure and economic growth can be the result of this. (Foryś, Głuszak, & Konowalczyk, 2019). However, evidence from socio-economic impact assessments made on the Dholera International Airport project in India, show that because of the construction only, around 200 skilled, semiskilled, and unskilled workers will be having direct employment, and after the construction is finished it is expected that the nearby area to be developed further for residential and commercial use (Nimesh, Hussain, & Sen, 2018).

In the same manner, The Negativity Bias theory (Monterrubio, Andriotis, & Rodríguez-Muñoz, 2020) helps to understand residents' perceptions by providing a theoretical framework for examining how individuals make overall evaluations and form general impressions about entities, in this case, airports. According to the theory, “negative events or impacts are perceived more strongly than positive ones, and when perceived negative impacts outweigh positive ones, a holistic evaluation that integrates both negative and positive events will ultimately be unfavorable” (Monterrubio, Andriotis, & Rodríguez-Muñoz, 2020). This theory helped in the understanding of how residents perceived the environmental and social effects of the New Mexico City Airport (NMCA) construction project in Mexico, even though its economic impacts were recognized as positive. Including local communities in the process of making

decisions can result in improved decision-making and avoid any potential forms of protest. (Monterrubio, Andriotis, & Rodríguez-Muñoz, 2020). Hence, a crucial application for upcoming policies and management in tourism is to include the participation of community members in decision-making procedures. This indicates that there is a requirement for transparent conversations regarding the advantages and disadvantages that might result from significant development projects before they are put into action.

New airport infrastructure affects regional tourism and economic development (Doerr, Dorn, Gaebler, & Potrafke, 2020). Empirical studies on this subject show that the construction or expansion of airports and their services increases international tourist flows, increases production, and employment, supports local economic development (Yang, Luo, & Ji, 2016), and creates positive ripple effects in neighboring areas (Doerr, Dorn, Gaebler, & Potrafke, 2020). To further support these findings, a case study of a new airport in the German region uses a synthetic control method to estimate the causal effect of the airport on tourist accommodations in the region (Doerr, Dorn, Gaebler, & Potrafke, 2020). The results show a significant and robust growth in the country where the airport is located, this is attributed to the arrival of international tourists. Also, it is possible that the size of the airport could be a relevant factor to consider when assessing the economic effects of new airport infrastructure (Doerr, Dorn, Gaebler, & Potrafke, 2020).

Furthermore, studies conducted on the Siena airport project showed that policymakers must have detailed attention when planning transport infrastructure for tourism (Bimonte, Ferrini, & Grilli, 2014). The research shows that improving access to a certain tourist destination does not equal its accessibility. Factors such as environmental impact and changing tourist preferences play a significant role in destination choices, not just easy access. These preferences should be considered by policymakers when analyzing projects to avoid wasteful investments (Bimonte, Ferrini, & Grilli, 2014).

Table 3. Main studies about the socioeconomic impact

Year	Context	Main Results	Reference
2014	A study was conducted on the Siena airport project.	The study highlights the importance of considering the environmental impacts of alternative transport infrastructures when planning tourism transport facilities.	(Bimonte, Ferrini, & Grilli, 2014)
2014	Case studies of aero-regionalism in airports from Chicago and Toronto.	The study demonstrates that airports are not only economic nodes in metropolitan areas but are also influenced by their regional context. The analysis emphasizes the need for inclusive and socially just governance of globally-integrated airports within city-regional networks.	(Addie, 2014)

2018	Case study on the Dholer International Airport development in India.	Infrastructure planners must offer a strong foundation in the form of fundamental infrastructure and a carefully thought-out future growth plan to guarantee the success of airport-led urban development.	(Nimesh, Hussain, & Sen, 2018)
2018	Case study on Katowice International Airport in Pyrzowice, Poland.	The development of the airport has also influenced the surrounding landside, resulting in urbanization and regionalization in connection with spatial planning. The airport's landside has become an area of broad spatial and functional connections, promoting the development of an airport city with various investments and economic activities.	(Rutkowski, 2018)
2019	Data was gathered from 709 claims around limited land use around Poznan-Lawica airport in Poland.	The current practice regarding damages awarded by courts for noise-related issues caused by airports has significant flaws. The distance from an airport and the location in the Land Use Plan (LUA) are factors that increase the risk of court proceedings. This goes against the intention of the legislator to make it easier for real estate owners to obtain compensation and avoid prolonging court proceedings.	(Foryś, Głuszak, & Konowalczyk, 2019)
2020	Studies on tourism development in 96 Bavarian counties from 36 tourism regions.	The results indicate that the presence of the regional commercial airport in Memmingen leads to significant and robust increases in tourist inflows, particularly from abroad. This suggests that new transportation infrastructure, such as airports, plays a role in promoting regional economic development.	(Doerr, Dorn, Gaebler, & Potrafke, 2020)
2020	23 interviews on the development of the new Mexico City International Airport.	Involving residents in decision-making processes regarding tourism and airport development is crucial. It emphasizes the need to consider residents' views, beliefs, and concerns from the early stages of planning and construction projects. This involvement can lead to better decision-making, minimize negative impacts, and prevent protests.	(Monterrubio, Andriotis, & Rodríguez-Muñoz, 2020)
2020	The study was conducted on regional airports in Sweden.	The results support the consideration of the resilience effects that an airport provides to the surrounding region and society in general in analyses of the social and economic effects of airports	(Grosse & M., 2020)
2020	An economic evaluation of the expansion project for the Oporto Airport.	The investment for the expansion is expected to be good from a socio-economic perspective. Despite the increase in environmental costs resulting from the expansion and increased traffic, the comparison of costs and benefits shows a positive differential, indicating that the investment in capacity is socioeconomically profitable.	(Gonçalves Costa, 2020)

Source: Own elaboration.

Environmental

Ecological and economic assessment is significant in land management restrictions for airport infrastructure because it helps to ensure a well-balanced approach to the development of airport infrastructure that considers both environmental and economic factors (Dobryak, Novakovska, Nikolaiev, & Skrypyk, 2019). The authors expose that the design and construction of the transport infrastructure must be done in a way that conserves open space and minimizes its impact on the environment.

Air traffic growth exacerbates the exposure to aircraft noise, which could significantly affect public health. Socio-acoustical surveys have shown that aircraft noise can lead to severe

conflict with people living in areas surrounding airports, highlighting the importance of mitigating its effects on public health and well-being (Licitra, Gagliardi, Fredianelli, & Simonetti, 2014). The author's research found that noise impact produced by commercial and military aircraft in 2021 during daytime was between 50 and 65 decibels and at night time between 40 and 50 decibels (Licitra, Gagliardi, Fredianelli, & Simonetti, 2014), while other studies have shown that measures between 50 and 60 decibels can have effects on speech interference, and measures between 40 and 50 decibels can cause the interruption of sleep (Sahrir, Bachok, & Osman, 2014). Improving aircraft manufacturing to reduce noise emissions, new techniques in landing and take-off procedures, and using noise demarcation lines can be solutions to mitigate this conflict (Scholl & Nebel, 2014).

Furthermore, research has been conducted on the environmental and health impacts of airport infrastructure upgrading, specifically focusing on Kuala Lumpur International Airport 2 (KLIA2) as a case study (Sahrir, Bachok, & Osman, 2014). The author's findings suggest that increased construction and land use had significant relations with noise and particulate matter levels, which can have negative effects on the health of the people from the nearby local community. For example, particle matter measuring up to 10 micrometers in diameter, found in dust from construction, can be small enough to inhale and accumulate in the respiratory system (Sahrir, Bachok, & Osman, 2014). Similarly, case studies on the expansion of the Hong Kong International Airport show that expanding the airport leads to more environmental costs than benefits such as more noise pollution, land use, water quality deprivation, and loss of ecosystems (Li & Loo, 2016). This is why, is imperative for the government and researchers to increase attention to the development of sustainable procedures and technologies for environmental protection, efficiency, and impact mitigation for locals.

Applying "green" logistics principles allows for a systematic approach to solving problems of aviation emissions reduction and developing environmentally efficient solutions throughout the whole cycle of air transport product creation (Sokolova, Grygorak, & Ivannikova, 2022). The authors establish that the most harmful influence on the ecosystem is done by air transport during the performance of logistics processes and operations at the airport. They propose a mechanism for the formation of a "green" airport in Ukraine, which represents a system of principles, methods, and tools of logistics management to reduce their negative impact on the ecosystem and achieve a high level of resource efficiency. However, implementing sustainable environmental practices in Ukrainian airlines is challenging due to the lack of effective mechanisms and state support for "green" initiatives. Despite the inherent

challenges in securing state support for green initiatives, the findings of this study hold significant potential for driving positive outcomes across nations prioritizing environmentally sustainable practices. Furthermore, it is crucial for future research endeavors to prioritize a deeper examination of the implications highlighted in this study. By directing attention toward this area, we can further enhance our understanding and advance the implementation of green initiatives on a global scale (Sokolova, Grygorak, & Ivannikova, 2022).

In addition, health promotion can be integrated into airport development to mitigate the negative impacts of the aviation sector by considering its determinants when designing and retrofitting airports (Crimeen, de Leeuw, & Freestone, 2018). Authors suggest that Health Impact Assessments (HIAs) can be conducted on airport-related proposals to identify potential risks and recommend measures to improve risk mitigation and strengthen health-promoting aspects of airports. Moreover, the paper suggests criteria for a more “health-focused airport”, such as "creating, maintaining and aligning with governance, policies, and practices for a sustainable ecosystem", "protecting as much as possible the natural ecosystems within and beyond the airport boundaries”, and “provides a clean, safe, high-quality physical environment for all people inside the airport boundaries and in surrounding communities” (Crimeen, de Leeuw, & Freestone, 2018).

Table 4. Main studies about the environmental impact

Year	Context	Main Results	Reference
2014	The study focused on the environmental impacts of the Kuala Lumpur International Airport 2 expansion.	To address noise pollution, recommendations include classifying areas and specifying ambient air quality standards for noise, implementing noise abatement measures, and erecting noise barriers in exposed areas. The overall conclusion emphasizes the importance of managing and administering transport services while considering social, economic, and environmental factors.	(Sahrir, Bachok, & Osman, 2014)
2014	The study was conducted at the Galileo Galilei Airport in Pisa, Italy.	Noise maps generated from simulations highlighted the impact of the airport on the population, given its proximity to residential areas. The proposed mitigation measures for the airport in the study would help reduce the noise impact on the population and enable future development.	(Licitra, Gagliardi, Fredianelli, & Simonetti, 2014)
2014	The study conducted on noise pollution refers to the Zurich Airport as an example.	Spatial planning is crucial in addressing the development of high-density traffic airports in densely populated areas. It emphasizes the importance of technological advances in reducing noise emissions and new techniques in landing and take-off. The use of noise demarcation lines was found to be a possible solution for this conflict.	(Scholl & Nebel, 2014)
2016	The study was conducted at Hong Kong International Airport	The framework used, aimed to enhance traditional Benefit-Cost Analysis (BCA) by considering a broader range of environmental impacts, such as habitat disturbance, noise pollution, and water pollution. It	(Li & Loo, 2016)

		acknowledges the importance of assessing and mitigating these environmental costs to promote more sustainable airport development projects.	
2018	Research on Western Sydney Airport	The authors propose that health promotion can be integrated into airport development to mitigate the negative impacts of the aviation sector and its land-based industries.	(Crimeen, de Leeuw, & Freestone, 2018)
2019	The study focuses on the impact of airport infrastructure on the environment and neighboring land.	Airports should focus on developing environmentally friendly transit routes. Served airports are advised to update their strategic plans every five years to ensure compliance and improve transport accessibility. The study proposes principles for assessing the environmental and economic impact of airport infrastructure and land use, aiming for environmentally friendly practices and effective territorial development.	(Dobryak, Novakovska, Nikolaiev, & Skrypnyk, 2019)
2022	Study to find and implement new technologies in the Ukrainian aviation sector.	There is a need to improve legislation and provide state support, regulation, and incentives for implementing "green" initiatives and structural changes in the aviation industry. The application of "green" logistics principles is seen as a systematic approach to reducing aviation emissions and developing environmentally efficient solutions throughout the entire cycle of air transport production.	(Sokolova, Grygorak, & Ivannikova, 2022)

Source: Own elaboration.

Sustainability

Sustainability in this review context is differentiated from environmental impacts by analyzing concepts on infrastructure resilience to climate change and its costs, sustainable development, and water management.

By adopting a long-term strategic approach that addresses the need for adaptation to climate change and mitigation of impacts on the environment, engineers can make sure that new airport infrastructure is sustainable and resilient (Ferrulli, 2016). For example, Ferrulli mentions how the London Heathrow Airport developed a comprehensive climate change adaptation strategy that includes measures such as flood risk management, water conservation, and energy efficiency. Another example listed is the Birmingham International Airport, which has implemented a method called “BUCCANEER (Birmingham Urban Climate Change and Neighbourhood Estimates of Environmental Risk)” for the assessment and reduction of the airport's risk to climate change (Ferrulli, 2016).

To minimize the carbon footprint of airports and enhance their ability to withstand climate change effects, the adoption of sustainable building materials with energy efficiency and low environmental impact is crucial (Greer, Rakas, & Horvath, 2020). For instance, incorporating materials that exhibit resilience against extreme weather occurrences like storms and floods can effectively safeguard airport infrastructure from potential damage (Ferrulli, 2016). Moreover, employing durable materials that require minimal maintenance can lead to

long-term cost reductions associated with airport infrastructure upkeep. Lastly, opting for recycled or locally sourced materials can play a significant role in curbing environmental consequences linked to airport construction projects, by diminishing transportation emissions and waste (Ferrulli, 2016).

Airports encounter several primary climate threats, which include:

- Increase of extreme weather events such as storms, floods, and heatwaves
- The rising sea levels coupled with the erosion of coastal areas.
- Alterations in temperature and precipitation patterns.

Ferrulli lists some mechanisms that airports can implement to mitigate these threats, such as:

- Climate change adaptation strategies include measures such as flood risk management, water conservation, and energy efficiency.
- Incorporating green infrastructure into airport design to manage stormwater and reduce the urban heat effect.
- Using sustainable building materials that are resilient to extreme weather conditions.
- Implementing renewable energy sources such as solar panels, wind turbines, and geothermal systems.

By implementing these measures, airports can become more resilient to climate change impacts while also reducing their environmental footprint (Ferrulli, 2016). Furthermore, The Green Airport Design Evaluation (GrADE) method can contribute to this stance to improving infrastructure planning by providing a systematic approach for evaluating and managing the environmental impact of airport infrastructure development (Ferrulli, 2016).

In addition, Dimitriou and Karagkouni, propose an evaluation framework for assessing the comprehensiveness of environmental mitigation strategies implemented by airport operators upon sustainable development concept. The framework considers five sub-criteria (e.g. Water conservation system, Water quality monitoring, Water runoffs management, Water consumption monitoring, and Wastewater treatment for the category of Water) for each category evaluated (emissions, noise, water, water ecosystems) and promotes a three-level (A, B, and C) environmental strategy assessment tool (Dimitriou & Karagkouni, 2022). The authors highlight key questions about the impact of effective air transport performance on business resilience and sustainable development, posing significant challenges for planners, managers, and policymakers. The findings suggest that further research could focus on a “quantitative

analysis of airports' environmental sustainability performance”, considering measurable outputs for different operational zones for each category correlating environmental impact mitigation with operational performance for instance, and airport performance for another (Dimitriou & Karagkouni, 2022).

Moreover, water management is related to this as it is one of the crucial environmental mitigation strategies that airports need to implement to achieve sustainable development (Dimitriou & Karagkouni, 2022). The correct use of water resources is crucial for the smooth and effective functioning of airports, especially in water-scarce areas. Numerous airports, particularly those in Mediterranean areas, already face water scarcity challenges (Dimitriou & Karagkouni, 2022). Major contaminants found in wastewater include surface water discharges, hand soap, cleaning chemicals, and sewage water from buildings (Bender & Sperry, 2020). Therefore, incorporating effective water management strategies is critical for airport operators to ensure their sustainable development and meet global regulatory frameworks' requirements (Dimitriou & Karagkouni, 2022).

Finally, and in addition to what has been previously stated, Chourasia, Jha, and Dalei state that for the correct development of a sustainable airport factors such as policies related to sustainability, return on investment, community involvement, water conservation, air and noise pollution, and service quality must be considered (Chourasia, Jha, & Dalei, 2020).

Table 5. Main studies about sustainability

Year	Context	Main Results	Reference
2016	Study based on scientific literature reviews.	Results show that infrastructure design plays a significant role in determining the environmental impacts of airports, and airports should address the uncertainties of climate change outcomes by planning for new infrastructure with climate change impacts in mind.	(Ferrulli, 2016)
2016	Study based on literature and web reviews.	The GrADE method and its tools are expected to contribute to achieving sustainable development in airport infrastructure by providing a framework for measuring and monitoring environmental sustainability performance. The method can help aviation regulatory organizations and airport operators define architectural and technological strategies to enhance sustainable airport infrastructure design.	(Ferruli, 2016)
2020	The study was conducted based on the review of existing literature.	For airport development projects to become sustainable, developers must address concepts such as sustainability issues and barriers, policy making, commerce, social responsibility, environmental concerns, and service quality.	(Chourasia, Jha, & Dalei, 2020)
2020	The study was conducted at the San Francisco International Airport	The paper focuses on the energy, water, construction materials, and Indoor Environmental Quality (IEQ) impacts as central considerations in designing and operating airports within the broader sphere of sustainability defined by the United Nations SDGs (Sustainable Development Goals).	(Bender & Sperry, 2020)

2020	Literature Review on airport sustainability	Research primarily focuses on specific aspects such as environmental impacts from airfield pavements and energy management strategies for airport buildings. However, other components of airports and different environmental emissions and impacts are not extensively studied.	(Greer, Rakas, & Horvath, 2020)
2022	Dataset based on information from 21 international airports	The paper introduces an evaluation framework for assessing the comprehensiveness of environmental mitigation strategies implemented by airport operators. European and U.S. airports tend to have more robust environmental strategies. Asian airports often focus on specific environmental categories. The study highlights the need for a larger sample size to draw more representative conclusions about airport environmental management in each region.	(Dimitriou & Karagkouni, 2022)

Source: Own elaboration.

DISCUSSION

After analyzing the considered literature, several conclusions can be drawn regarding the impact of airport infrastructure on the economy, society, environment, and sustainability. This part of the paper analyses the correlation between these factors and highlights the need for a comprehensive approach to the development and management of airports.

From an economic perspective, it is set clear that airports play a vital role in promoting regional development and economic progress. Empirical evidence suggests that airport development has a positive correlation with regional economic benefits (Bai & Wu, 2022). Additionally, the long-term causality relationship between airport development and regional economic development indicates that leveraging airport infrastructure can significantly improve the regional economy. Nonetheless, airport capacity and traffic characteristics should be considered since the economic impact can differ among airports because of these factors.

Socioeconomic factors are also affected by airport infrastructure. Land use restrictions near airports can hinder economic growth and development, leading to social losses. Negative impacts, such as noise pollution, can outweigh positive economic effects, and involving local communities in decision-making processes can lead to better outcomes. Additionally, the construction or expansion of airports can enhance regional tourism, international flows, and economic development. It is important to consider the causal effects of airport infrastructure on tourism and economic growth when planning for future development.

Addressing the environmental impact of airports emerges as a vital concern. There is a need for the implementation of measures to mitigate noise pollution, air pollution, and other detrimental environmental effects linked to airport operations. To reduce the carbon footprint and improve their resilience to climate change impacts, airports can implement practices such as green logistics, green infrastructure and the adopting the use of sustainable building

materials. Furthermore, in water-scarce regions, the adoption of effective water management strategies becomes crucial for promoting sustainable development.

Lastly, sustainability should be a guiding principle in airport infrastructure development. Long-term strategic approaches that address climate change adaptation, mitigation, and the use of sustainable materials can ensure the resilience and environmental efficiency of airports. Evaluating the comprehensiveness of environmental mitigation strategies is essential, and further research is needed to quantitatively analyze airports' sustainability performance.

In conclusion, airport infrastructure has significant economic, socio-economic, environmental, and sustainability impacts. Recognizing the correlation of these factors is crucial for making informed decisions and implementing effective policies in airport planning, development, and management. By considering the multifaceted effects and adopting sustainable practices, airports can contribute to regional economic growth, community well-being, environmental preservation, and a resilient and sustainable future.

FUTURE RESEARCH

This systematic literature review on the impacts of airport development brings new research opportunities to the table. Here are some research recommendations for a deeper understanding of the economic, socio-economic, environmental, and sustainability impacts of airport infrastructure.

The impact of airport infrastructure on regional development is considered significantly across the analyzed papers. However, topics such as the effects on employment and tourism should be studied further. Government policies and global economic conditions are external factors that affect the relationship between airports and regional economic development, such effects, and causalities should be researched further as well. Furthermore, the authors suggested that future research could examine the impact of airport-based sub-centers on regional polycentric growth and promote closer collaboration among provincial airports, including the airline network, flight schedules, and air service quality (Bai & Wu, 2022).

When it comes to socioeconomic impacts, as mentioned before, future research should be focused on residents' quality of life, health, and well-being. To avoid locals' discomfort and negative response, the effectiveness of different public consultation methods with local communities in the decision-making process, especially when it comes to large-scale developments projects, should be researched further (Monterrubbio, Andriotis, & Rodríguez-

Muñoz, 2020). This could lead to more research on how different types of airport impacts are perceived by different groups within local communities. This could result in how residents' attitudes towards airport impacts differ across countries or regions, making it especially useful for project developers.

Further potential areas of research should be the ones focused on creating compensation models for landowners when affected by airport developments and policy restrictions. Some authors suggest that more research could be conducted to evaluate the creation of different compensation models and to identify better practices among different countries and not just Poland, which is the one studied in the literature (Foryś, Głuszak, & Konowalczyk, 2019). Additionally, more research is needed to better understand the economic impact and assessment of damages subject to property claims by landowners. To complement these research theories, additional studies could be conducted to evaluate the effectiveness of state intervention when it comes to the mitigation of conflicts between project developers and landowners.

When it comes to tourism, research can focus on the impact airport infrastructure has on different types of it, such as cultural or eco-tourism, and how it affects the sustainability of tourism development. The role of airport infrastructure in promoting regional innovation and entrepreneurship, and social equity should also be further analyzed (Doerr, Dorn, Gaebler, & Potrafke, 2020). Potential trade-offs between economic benefits and environmental costs associated with new airport infrastructure are a strong recommendation for investigation, especially in the context of climate change mitigation and adaptation.

In the manner of environmental impacts from airport infrastructure, the revised literature suggests many potential areas for future research besides the ones previously mentioned. For starters, the effect of noise pollution. On this matter, this year the ICAO (International Civil Aviation Organization) Council, the agency that oversees international air navigation, has updated its standards by adding 16 new amendments to “address aircraft noise and aircraft noise emissions” which will have an applicability date of January 1st, 2024 (ICAO, 2023). Researchers will have to be alert to the new technologies that aircraft and airport developers will propose to address these changes and how these new amendments will have, or not, an actual beneficial impact on communities in the surrounding areas.

Academic research should also focus on how to improve airport operations by reducing energy consumption. For this, as of March 2023, Italy has moved forward by actively changing the regulatory measures that prevented airports from producing and using sources of renewable energy on their premises. These new changes in regulations will facilitate the authorizations

needed to install “renewable energy plants” at Italian airports. Future research will have to focus on the effects such regulatory changes bring to the reduction of energy consumption, and reduction of carbon emissions, so that other European countries can follow (Moore, 2023).

Even though there exists sufficient evidence that proves the use of renewable energy sources like solar panels and wind turbines is beneficial for the environment, new opportunities arise with the discovery of new technologies, like the use of hydrogen as a source of clean energy. Airports in important hubs like Singapore (Changi Airport, Airbus and others explore creation of hydrogen hub, 2022) and Canada (Sporrer, 2022) are already betting on this type of fuel to reduce their carbon footprint. However, being this technology so new, researchers have the task to analyze the results this will bring to the ones that opt for this type of clean energy source and see if it aligns with sustainability goals set by the airports that implement it so that others can follow.

Finally, on sustainability, academic research has focused on climate change, airport resilience to climate change, and resource management. Airports around the world are already being operated partially, if not completely, by renewable energy sources. However, in case of emergency, almost all of them rely on fossil fuels to keep operating during power disruptions. JFK Airport, in New York City, is pioneering a power grid that will keep the airport fully operational during power disruptions, a power that will be coming from energy stored in “power islands” which are charged by solar panels (Markind, 2023). Results are yet to be presented, it will be a task for academia to explore and analyze to see if it would be feasible to implement this type of energy storage in other airports around the world.

CONCLUSION

In this research, I investigated the impacts airport infrastructure developments have on economic, socio-economic, environmental, and sustainable factors through a systematic review of the literature. The results demonstrate that airport infrastructure has positive impacts on regional development even in situations where there is a negative bias against its development. Moreover, even when most studies approach the matter of airport development from different perspectives and topics, every author concludes that airport infrastructure is an important catalyst to economic and social development, due to the connectivity and job opportunities it creates, and that the environmental consequences of such developments have always to be in mind. Furthermore, it is imperative to be on the lookout for new technologies and strategies so that airports can become more sustainable in the future and reduce the carbon emissions and waste that they produce.

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APPENDIX

Table 6. Summary of the literature reviewed

Publication Year	Topic	Variable	Methodology	Theory	Main Result	Authors
2022	Economic development through airport infrastructure in Senegal.	Economic impact	Quantitative method	Copeland framework 1991	The main conclusion of the paper is that while public investment in airport construction positively affects GDP, it negatively impacts foreign demand for tourism services. Reducing taxation on the fee for the development of airport infrastructure (RDIA) would stimulate the tourism sector and overall economic growth in Senegal.	Sipoaka, Assion Lawson; Cabral, Francois Joseph
2022	Economic Development and People's Perception through airport infrastructure on a regional level in South Korea	Economic impact	Mixed method	Confirmatory factor analysis	The study identifies five factors that significantly affect public perceptions. Positive effects are perceived more clearly than negative effects, but the study acknowledges limitations in considering concentrated damages like noise. Regional development around airports is seen as advantageous for building consensus. Strategies should be developed to address negative effects and foster public confidence. The study provides insights and recommendations for promoting airport development based on social consensus.	Song, Ki-Han; Suh, Wonho
2022	the harmful impact of global air transport on the environment and the proposal for a mechanism for the implementation of green logistics to reduce the negative impact on the ecosystem and achieve a high level of resource efficiency	Environmental impact	Qualitative method	Empirical studies	There is a need to improve legislation and provide state support, regulation, and incentives for implementing "green" initiatives and structural changes in the aviation industry. The application of "green" logistics principles is seen as a systematic approach to reducing aviation emissions and developing environmentally efficient solutions throughout the entire cycle of air transport production.	Sokolova, Olena; Grygorak, Mariya; Ivannikova, Viktoriiia
2022	Effects of airport development on economic growth across three Chinese macro-regions.	Economic impact	Quantitative method	Solow's (1956) neoclassical growth model. Aschauer (1989) Demurger (2001) The NEG model	Airports drive economic growth in countries and regions by increasing regional trade, job opportunities, urban development, and spatial spillover effects. However, air transport development can further deepen regional inequalities and economic divergence. Public investment in air transport can have positive growth prospects but may also exacerbate income disparities	Wong, David Wai-Ho; Zhao, Simon Xiao-Bin; Lee, Harry Fung

Publication Year	Topic	Variable	Methodology	Theory	Main Result	Authors
2022	responsible infrastructure development and company sustainability	Sustainability	Quantitative method	Empirical studies	The paper introduces an evaluation framework for assessing the comprehensiveness of environmental mitigation strategies implemented by airport operators. European and U.S. airports tend to have more robust environmental strategies. Asian airports often focus on specific environmental categories. The study highlights the need for a larger sample size to draw more representative conclusions about airport environmental management in each region.	Dimitriou, D., Karagkouni, A.
2022	Transportation Infrastructure and its Impact on economic development	Economic impact	Quantitative method	Vector Error-Correction Model (VECM),	The results of the case study show that the access of cities to transportation networks strongly influences economic development and population size in Iran. It was also found that among the transport networks, road transport is more correlated with economic development and unemployment rate of Iranian cities compared to other transport modes.	Faghihinejad, F., Mohammadi Fard, M., Roshanghalb, A., Beigi, P.
2022	causality between airport development and regional economic growth	Economic impact	Mixed Method	Granger Causality Test	leveraging airport development is important for improving the regional economy. The study emphasizes the need for long-term strategic spatial planning and closer collaboration among Jiangsu provincial airports, including aspects such as airline networks, flight schedules, and air service quality.	Bai, Y., Wu, C.-L.
2021	How to make an airport development project more sustainable.	Sustainability	Mixed method	Sustainability Theory	For airport development projects to become sustainable, developers must address concepts such as sustainability issues and barriers, policy making, commerce, social responsibility, environmental concerns, and service quality.	Chourasia, A.S., Jha, K., Dalei, N.N.
2021	Impact of airport infrastructure on the Level of logistics services	Economic impact	Quantitative method	Neoclassical Economics theory	Focusing on the quality of transport infrastructure, rather than just the quantity, has significant implications for the economic development of developing countries. The authors highlight the importance of integrating transport infrastructure for better business opportunities and emphasize the need for increased collaboration between different stakeholders, including government and private agents such as logistics providers. Their results suggest that governments should prioritize logistics reforms to increase trade opportunities at a lower cost and in less time.	Sénquiz-Díaz, C.

Publication Year	Topic	Variable	Methodology	Theory	Main Result	Authors
2020	Impact of airport development project on regional and local tourism.	Socio-economic impact	Qualitative method	Negativity Bias Theory	Involving residents in decision-making processes regarding tourism and airport development is crucial. It emphasizes the need to consider residents' views, beliefs, and concerns from the early stages of planning and construction projects. This involvement can lead to better decision-making, minimize negative impacts, and prevent protests.	Monterrubio, Carlos; Andriotis, Konstantinos; Rodriguez-Munoz, Gregoria
2020	Social benefits from the expansion of the Oporto Airport	Socio-economic impact	Quantitative method	N/A	The investment for the expansion is expected to be good from a socio-economic perspective. Despite the increase in environmental costs resulting from the expansion and increased traffic, the comparison of costs and benefits shows a positive differential, indicating that the investment in capacity is socioeconomically profitable.	Goncalves Costa, Vania Natercia
2020	Impact of airport infrastructure on Tourism	Socio-economic impact	Quantitative method	Synthetic control model	The results indicate that the presence of the regional commercial airport in Memmingen leads to significant and robust increases in tourist inflows, particularly from abroad. This suggests that new transportation infrastructure, such as airports, plays a role in promoting regional economic development.	Doerr, L., Dorn, F., Gaebler, S., Potrafke, N.
2020	Review on airports' environmental impact and sustainability	Sustainability	Quantitative method	Empirical studies	The systematic review reveals that research primarily focuses on specific aspects such as environmental impacts from airfield pavements and energy management strategies for airport buildings, while other components of airports and different environmental emissions and impacts are not extensively studied. The review also highlights a lack of research on indoor air quality at airports and a lack of consensus regarding the scope of environmental impacts to be included in assessing overall airport sustainability.	Greer, F., Rakas, J., Horvath, A.
2020	Effects of Airports on societal resilience	Socio-economic impact	Qualitative method	Empirical studies	The results support the consideration of the resilience effects that an airport provides to the surrounding region and society in general in analyses of the social and economic effects of airports	Große, C., Olausson, P.M.
2020	Airport sustainability	Sustainability	Mixed Method	Empirical studies	The paper focuses on the energy, water, construction materials, and Indoor Environmental Quality (IEQ) impacts as central considerations in designing and operating airports within the broader sphere of sustainability defined by the United Nations SDGs (Sustainable Development Goals).	Bender, G., Sperry, R.

Publication Year	Topic	Variable	Methodology	Theory	Main Result	Authors
2020	relationship between Air transport and regional development in Turkey	Economic impact	Mixed Method	Two-Stage Least Squares (2SLS) Generalized Spatial Two-Stage Least Squares (GS2SLS)	The deregulation of policies concerning the aviation industry and the heavy investment in transport infrastructure in Turkey have shown positive effects on the economy in all their regions.	Elburz, Z., Nijkamp, P., Pels, E.
2019	the effects of the negative impact of airport noise resulting in limitations to residential buildings' usability and depreciation of their market value	Socio-economic impact	Mixed method	Coase's theory	The current practice regarding damages awarded by courts for noise-related issues caused by airports has significant flaws. The distance from an airport and the location in the Land Use Plan (LUA) are factors that increase the risk of court proceedings. This goes against the intention of the legislator to make it easier for real estate owners to obtain compensation and avoid prolonging court proceedings.	Forys, Iwona; Gluszak, Michal; Konowalczyk, Jan
2019	need for ecological and economic assessment of land management restrictions for airport infrastructure.	Environmental impact	Mixed method	Empirical studies	Airports should focus on developing environmentally friendly transit routes. Served airports are advised to update their strategic plans every five years to ensure compliance and improve transport accessibility. The study proposes principles for assessing the environmental and economic impact of airport infrastructure and land use, aiming for environmentally friendly practices and effective territorial development.	Dobryak, D.S., Novakovska, I.O., Nikolaiev, K.D., Skrypnik, L.R.
2018	Transit-oriented development and strategies for augmenting socio-economic infrastructure around Greenfield Airport"	Socio-economic impact	Mixed method	Empirical studies	Infrastructure planners must offer a strong foundation in the form of fundamental infrastructure and a carefully thought-out future growth plan to guarantee the success of airport-led urban development.	Nimesh, V.; Hussain, M. S.; Sen, J.
2018	Impact of airport development on political, economic, socio-cultural, and technological elements.	Socio-economic impact	Qualitative method	Empirical studies	The airport's growth and modernization have made it attractive to investors and businesses, leading to good profits. The development of the airport has also influenced the surrounding landside, resulting in urbanization and regionalization in connection with spatial planning. The airport's landside has become an area of broad spatial and functional connections, promoting the development of an airport city with various investments and economic activities.	Rutkowski, Marcin
2018	Effect of airport facilities on population health	Environmental impact	Mixed Method	Empirical studies	The authors propose that health promotion can be integrated into airport development to mitigate the negative impacts of the aviation sector and its land-based industries.	Crimeen, A., de Leeuw, E., Freestone, R.

Publication Year	Topic	Variable	Methodology	Theory	Main Result	Authors
2017	economic impact and operational challenges faced by regional airports.	Economic impact	Quantitative method	Input-Output Models	Determining whether the indirect, induced, and catalytic impact of an airport on a region outweighs the cost of regional airport subsidies would contribute to informed regional development policy and decision-making	Kazda, A., Hromádka, M., Mrekaj, B.
2016	Sustainability in airport development projects	Sustainability	Quantitative method	Green Airport Design Evaluation (GrADE) method	The GrADE method and its tools are expected to contribute to achieving sustainable development in airport infrastructure by providing a framework for measuring and monitoring environmental sustainability performance. The method can help aviation regulatory organizations and airport operators define architectural and technological strategies to enhance sustainable airport infrastructure design.	Ferrulli, P.
2016	Evaluation of transport projects	Environmental impact	Mixed method	Benefit-Cost Analysis	The framework used, aimed to enhance traditional Benefit-Cost Analysis (BCA) by considering a broader range of environmental impacts, such as habitat disturbance, noise pollution, and water pollution. It acknowledges the importance of assessing and mitigating these environmental costs to promote more sustainable airport development projects.	Li, L., Loo, B.P.Y.
2016	Climate change and its effects on airport development planning	Sustainability	Qualitative method	Green Airport Design Evaluation (GrADE) method	Results show that infrastructure design plays a significant role in determining the environmental impacts of airports, and airports should address the uncertainties of climate change outcomes by planning for new infrastructure with climate change impacts in mind.	Ferrulli, P.
2015	Impacts of regional air transport on regional economic growth	Economic impact	Mixed method	Granger Causality Framework	Regional aviation and airports have causal relationships with economic growth. This relationship should be considered when planning and funding airports in regional communities. Financial support should be directed towards remote airports, and subsidies should be adjusted based on economic conditions.	Baker, D., Merkert, R., Kamruzzaman, M.
2014	environmental concerns in airports growth are noise and air quality	Environmental impact	Quantitative method	Empirical studies	To address noise pollution, recommendations include classifying areas and specifying ambient air quality standards for noise, implementing noise abatement measures, and erecting noise barriers in exposed areas. The overall conclusion emphasizes the importance of managing and administering transport services while considering social, economic, and environmental factors.	Sahrir, Syazwani; Bachok, Syahriah; Osman, Mariana Mohamed

Publication Year	Topic	Variable	Methodology	Theory	Main Result	Authors
2014	Noise Pollution in populated regions near airport infrastructures	Environmental impact	Quantitative method	Raum approach	Spatial planning is crucial in addressing the development of high-density traffic airports in densely populated areas. It emphasizes the importance of technological advances in reducing noise emissions and new techniques in landing and take-off. The use of noise demarcation lines was found to be a possible solution for this conflict.	Scholl, Bernd; Nebel, Reto
2014	Relationship between air transportation and tourism development	Socio-economic impact	Quantitative method	Lancaster demand theory	Results show that tourists are less influenced by factors like distance and cost and are more interested in factors such as time, transport mode, and environmental impact. The study highlights the preference of tourists for enhancing destination accessibility through improved ground connections with existing regional airports rather than developing a local airport.	Bimonte, S., Ferrini, S., Grilli, G.
2014	Aero-regionalism	Socio-economic impact	Qualitative method	Empirical studies	Aero-regionalism provides insights into the planning and governance of major airports within the context of global city-regionalization. The study demonstrates that airports are not only economic nodes in metropolitan areas but are also influenced by their regional context. The analysis emphasizes the need for inclusive and socially just governance of globally-integrated airports within city-regional networks.	Addie, J.P.D.
2014	Noise impact of airports close to cities	Environmental impact	Quantitative method	Integrated Noise Model (INM)	Noise maps generated from simulations highlighted the impact of the airport on the population, given its proximity to residential areas. The proposed mitigation measures for the airport in the study would help reduce the noise impact on the population and enable future development.	Licitra, G., Gagliardi, P., Fredianelli, L., Simonetti, D.
2013	Airport Development in Germany and its Impact	Economic impact	Quantitative method	Aschauer (1989)	The output effects of air transport vary significantly among airports due to factors such as capital appropriation and traffic characteristics. The study acknowledges the limitation of not directly capturing traffic patterns in their model and suggests incorporating information about traffic characteristics and transfer traffic in future research.	Allroggen, F., Malina, R.

Source: Own elaboration.