

The Role of Regional Airports in Connectivity and Regional Development

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Abstract

This article analyzes the contribution of regional airports in Colombia to the development of the domestic air transport network, and with it, to the connectivity of the regions and their social and economic development. The growth and evolution of Colombian regional airports are supported and driven by a set of public and investment policies, designed exclusively for the air sector and implemented, almost continuously, since the liberalization of the air transport industry in the country in the early 1990s and are still in development. Having said this, this work analyzes how the network of regional airports have been able to develop in two and a half decades through public policies, and later, how these airports have positively impacted connectivity and socioeconomic development in the territories. All this is done through the presentation and analysis of related indicators.

Keywords

regional airports, air transport, transport policy, territorial connectivity, Colombia

1 Introduction

Air transport plays an important role in today's globalized society. There is a growing understanding among governments around the world that air connectivity is an asset that improves the global competitiveness of cities, regions and countries. Connectivity growth lowers travel costs for consumers and businesses and facilitates global commerce and contacts. There is increasing evidence that the growth of air connectivity stimulates productivity, foreign direct investment, tourism, etc., in the different regions of a country (Burghouwt, 2017). Because of this, many governments formulate public policies in their air transport industries to influence and improve connectivity results at the regional level, in order to achieve a connectivity portfolio that better meets the needs of local societies (Van de Vijver et al., 2014).

In this context, and at the national level, regional airports are of significant importance in at least two aspects. Firstly, regional airports strengthen domestic air connectivity and with it the territorial cohesion of a country. This generates important socio-economic benefits for regional communities by facilitating business and industrial developments, encouraging internal foreign direct investment, and promoting interregional trade in goods and services (ITF, 2018a). Secondly, regional airports provide vital support to so-called

essential air services, for example for medical care, social services, public security, education, basic needs supplies, etc., for those remote or isolated communities where no way of transport facilitates accessibility and, if it does, it is with great difficulty or limited (Fageda et al., 2019). Finally, there is also a social function of regional airports, namely, to provide adequate air connectivity to peripheral and isolated regions to make them more attractive to current and future inhabitants, and, therefore, to maintain the populations of those regions, in other words, to avoid a massive or staggered depopulation (Tveter, 2017).

In Colombia, the country chosen as the case study for this research, regional airports have played an essential role in regional connectivity. The country is the seventh largest on the American continent, has an area of 1.14 million km², with an insular region in the Caribbean Sea 775 km from the Atlantic coast and 42.3 % of the continental territory is Amazon rainforest. Under these conditions air transport is, in many cases, the only possible alternative for accessibility to remote, peripheral and isolated regions. The importance of regional airports is strengthened if poor geographical coverage of the national road network and a non-existent rail network for the transport of passengers

and goods are added to the geographical characteristics of the country (Díaz Olariaga and Carvajal, 2016). For all these reasons, the Colombian Government, aware of the importance of domestic air transport and regional airports, has been implementing public and investment policies for a little over two decades with the aim of improving, expanding and technologically modernizing the airport infrastructure in all regions of the country. Undoubtedly, the liberalization of the aviation industry in the country in the early 1990s helped the progressive development of domestic air transport and the airport network (Díaz Olariaga, 2017). Having said this, this article analyzes the contribution of regional airports to connectivity and the development of the territories in Colombia through various indicators (aeronautical and socioeconomic) and using public air policies as fundamental basis for analysis.

2 Conceptual framework

2.1 Basic concepts of regional airport

Firstly, there are several ways or semi-formal proposals to classify or group airports according to certain functional characteristics (Postorino, 2010). In terms of passengers and movements airports can be defined as:

1. primary or main, if the number of annual passengers exceeds a certain figure; and
2. regional, when the volume of annual passengers is less than that figure, within this group there may be some subdivisions, for example, regional large, medium, small, very small.

According to the International Civil Aviation Organization, in Annex 14 (ICAO, 2018) it establishes that an airport can be classified according to the traffic density of the airport, such as the number of movements per runway during rush hour. Depending on its function within the network, an airport can be classified as: hub or feeder. Finally, according to the type of routes offered and their associated distances, airports can be classified as:

1. first level airports, with intercontinental and international destinations covering distances greater than 3,000 km;
2. second level airports, with national and international destinations covering distances equal to or less than 3,000 km;
3. and third level airports, with national destinations covering distances in the range of 300–1,000 km.

In another order, there are several attempts to define a regional airport; these link the notion of regional or

non-central with the fact that the area of influence of an airport is outside a capital city. In the European Union, at least to date, there is no formal definition of a regional airport with the aim of developing related public policies. In the United States the Federal Aviation Administration subdivides airports with commercial traffic into primary and non-primary airports, depending on the annual number of passengers boarded (FAA). And finally, a recent study (ACI Europe, 2017) considers that the catchment area or the annual traffic of an airport are not valid indicators to determine whether an airport is regional or not, therefore, this study affirms that an airport should be considered regional if:

1. it mainly serves short and medium-range routes;
2. and primarily serves point-to-point destinations.

2.2 The role of regional airports in connectivity and development of the territories

Regional airports are essential transport nodes that facilitate the proper functioning of a country's internal market by connecting people, products and services; they also enable economic activity and growth, expand the horizon of traditional trade routes, and provide a significant boost to cities and regions by increasing accessibility and improving social cohesion and development (Baker and Donnet, 2012).

In many regions within the countries, there are few efficient or even viable alternatives to air transport, due to a combination of factors including distance, low population density, geographic restrictions, adverse weather, etc. Airports in these regions are often the only means of facilitating access to essential services for those communities. They also support economic and social integration, allowing businesses to connect and citizens to travel for work. Regional airports and the air services they provide are, therefore, extremely relevant when looking at local development and the containment of severe depopulation, that is, they prevent massive or staggered emigration to large cities (Redondi et al., 2013).

Many governments formulate public air transport policies to, among others, improve connectivity between their territories; their arguments are diverse, the most important are:

1. economic, such as productive development, generation of employment and wealth, etc.;
2. and socio-political, such as territorial integration and cohesion ones (Burghouwt, 2017; Burghouwt and Redondi, 2013).

Regarding the first argument, i.e. economic, air transport is considered to be an enabling factor for broader economic

development in a region (Van de Vijver et al., 2016). An analysis of the existing bibliography on the subject confirms that passenger air transport and employment in different industrial sectors in urban regions are positively linked (Alkaabi and Debbage, 2007; Brueckner, 2003; Button and Taylor, 2000; Goetz, 1992; Green, 2007; Ivy et al., 1995; Liu et al., 2006; Neal, 2012). The reason for these claims is the observation that better air transport services imply better accessibility, which encourages companies to locate in a region and stimulates the expansion of existing businesses (Cooper and Smith, 2005; Zak and Getzner, 2014). This improvement in accessibility and connectivity appears to contribute to positive results at an overall economic level by improving productivity levels, thanks to greater access to other markets and better movement dynamics of workers between regions (Button et al., 1999; Mukkala and Tervo, 2013; Neal, 2012; Perovic, 2013). And finally, some research affirms that employment in the services sector is derived from the assumption that the service industry is more sensitive to passenger air transport than to other sectors of the economy (Bel and Fageda, 2008; Debbage, 1999; Denstadli, 2004; Faulconbridge et al., 2009; Percoco, 2010; Van de Vijver et al., 2014).

The airports of the regions are now definitely defining the economies of their communities, that is, they are drivers of the socioeconomic development of the territories. Regional airports become catalysts for economic regeneration and growth (ITF, 2018b).

2.3 Regional airports as support for essential air services

Given the link between connectivity and economic growth, public managers are interested in appropriate mechanisms to effectively promote air transport, not only in large economic centers, but also in remote areas, which would be excluded under normal market conditions. Globally, it is easy to find countries with regions or territories to which routes are not profitable for local airlines, mainly due to the low or almost zero volume of regular passengers transported, in other words, low or very low demand, which does not facilitate the development of adequate air transport connections. However, due to the social, economic and even geopolitical importance of remote, outermost or isolated communities, many countries formulate public policies aimed at providing and guaranteeing air connectivity to these regions. These policies lead to what are known as essential air services or also public service obligations (Fioravanti et al., 2018).

Globally, many countries develop public policies to provide air connectivity to remote regions, and those policies are due to the country's particular characteristics and situation. In

general, these public policies can be classified into four large, well-differentiated groups (Fageda et al., 2018):

1. route-based policies;
2. passenger-based policies;
3. airline-based policies;
4. and airport policies.

In all of these policies, the regional airport, whatever its type or size, is key to supporting essential air services.

3 Case study: Colombian air policies

3.1 Airport public policy

Since the mid-1990s, and in various time phases called generations, the Colombian public sector has concessioned several airports in the country, a total of 19 to date of the 46 owned by the Colombian state open to commercial traffic, in order to obtain a better administration, modernization, expansion, operation, commercial exploitation and maintenance of the air terminals (see Fig. 1) (Pulido Moreno and Díaz Olariaga, 2019). In accordance with the objective set for airport concessions, the company, the partnership, the consortium or the concessionaire entity of the airports performs only as administrator and operator. Concessioned airports are large, medium and small in terms of annual volume of passengers managed, and are distributed throughout almost the entire country (see Fig. 1).

At the same time, the airport concessions policy was accompanied by an important public investment policy in the airports managed by the State, which has not stopped for two decades. In contrast, private investment in airports has evolved according to the dynamics of the concessions, going from non-existent in 1996 at the start of the first concessions, to 20 % as a percentage of the GDP of air transport in 2010 (Díaz Olariaga, 2016). Between 1993 and 2018, public investment in airport infrastructure was approximately USD 1,728 million, mainly in medium and small airports; while private investment was USD 1,612 million (period 1996-2015), and USD 570 million (period 2016-2018) (ANI), produced in the four generations of airport concessions, covering all types of airports, large, medium, small and very small (ANI; MinTransporte, 2018; Ortiz and Romero, 2016).

3.2 Air connectivity policies for remote and isolated regions

Colombia has a complex geography that hinders connectivity and territorial accessibility by land, for example:

1. the country is crossed from southwest to northeast by three mountain ranges of the Andes mountain range;

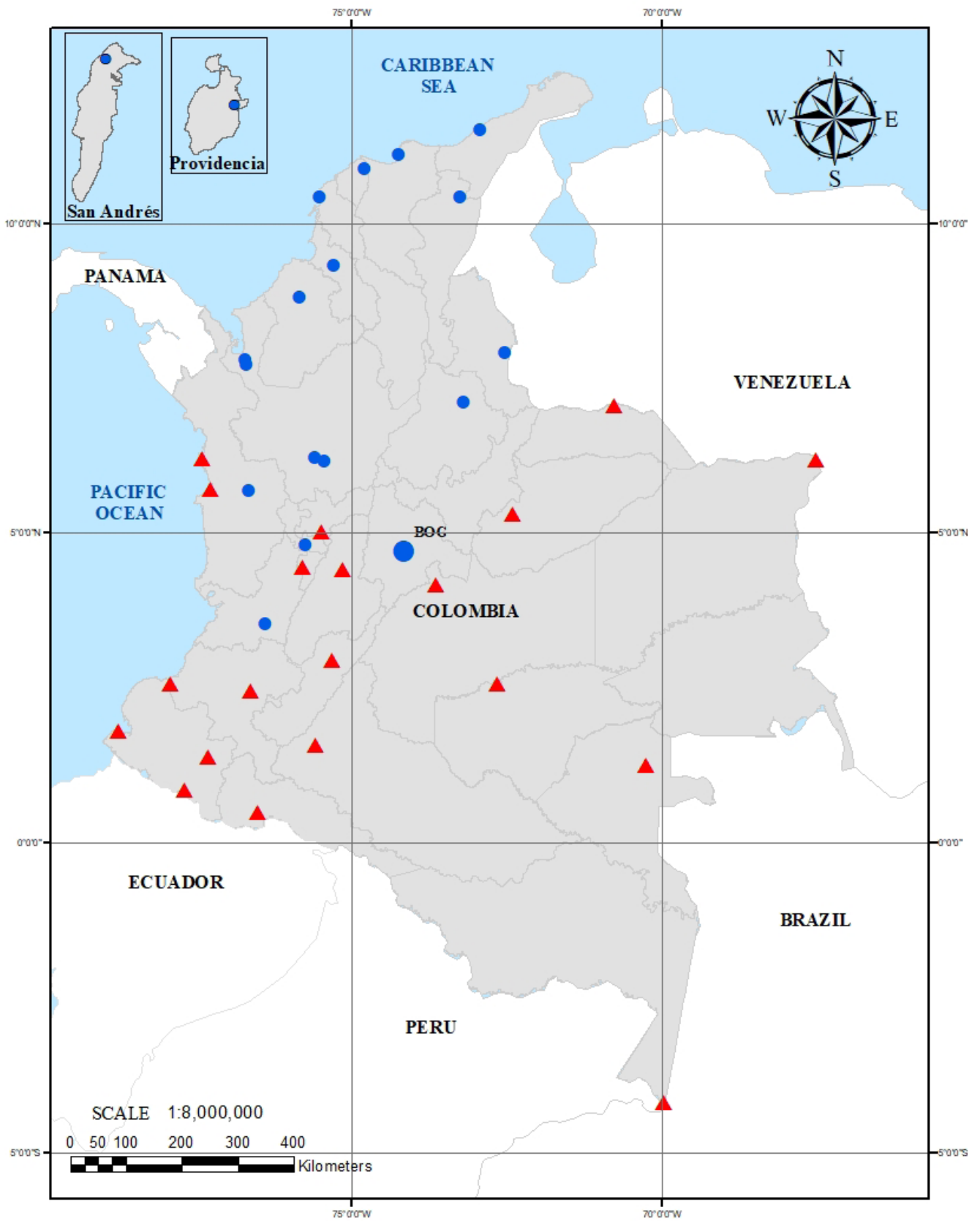


Fig. 1 Airports under study. *Description:* blue circle: airport with private governance; red triangle: airport with public governance; BOG is the IATA code of the country's main airport in the capital city (does not participate in the study). Own edition based on data from Aerocivil (2020).

2. the country has an insular region in the Caribbean Sea (the archipelago of San Andrés, Providencia and Santa Catalina) 775 km from the Colombian Atlantic coast; and
3. 42.3 % of the continental territory corresponds to the Amazon rainforest (southeast part of the country). Added to this geographical situation, Colombia presents a great deficiency in coverage and capacity of communication systems in the land-road and rail systems, the latter being practically non-existent (Díaz Olariaga and Carvajal, 2016). Ultimately, all this leads to air transport in Colombia being vital and with a more than relevant role in territorial connectivity.

Thus, the public policy adopted in Colombia for air access to remote and isolated regions corresponds to the so-called airline-based policy. Thanks to this, at present, essential air services in Colombia are provided by the public operator SATENA, whose objective is to provide air passenger, mail and cargo service as a priority, to the less developed regions of the country and connect by air those regions where no other operator reaches; in this way, it guarantees connectivity and territorial integration (Aerocivil, 2016). It is worth mentioning that the public operator SATENA also operates profitable domestic routes, in direct competition with private operators present in the Colombian air market.

In another order, the Colombian aeronautical authority must guarantee air connectivity by the public air operator to the so-called areas most affected by the conflict, municipalities and remote or peripheral communities that suffered a great social and humanitarian impact during the armed conflict in the country, which lasted for five decades and ended with the signing of the peace agreement in 2016. Air connectivity services to these vulnerable municipalities are called social routes, and are provided by the public air operator SATENA from main and secondary airports. Likewise, the coverage of social routes goes beyond the aforementioned areas; the criteria to identify a beneficiary community of a social route are the following (DNP, 2019):

1. geographical location;
2. infrastructure;
3. public order;
4. poverty;
5. development environment;
6. vulnerable communities;

7. tourism potential;
8. and regional connection.

4 Impact of Colombian public air policies

4.1 Structure of the airport network

The Colombian airport network has not changed in the last three decades, that is, no new airports have been built. But, as mentioned, both airport concession policies and public investment policies contributed to the technological expansion and modernization of almost all the airports in the network, a process that is still ongoing.

For the present research, a group of 38 regional airports was chosen, considering as regional the aforementioned criteria of ACI Europe (2017), that is: medium-large, medium, small and very small, of which only four operate international flights, but the bulk of their air traffic is domestic, and, finally, most of these airports serve short- and medium-range point-to-point destinations. Fig. 2 shows the geographical location of all the airports under study; the country's main airport, Bogotá-El Dorado (BOG), was included, but only as background information, since it does not participate in the study because it does not have the status of a regional airport; on the contrary, it is the third air terminal in Latin America (based on the volume of passengers transported), statistics as of 2019: 32.7 M Pax and 723,000 Tn air cargo (Aerocivil, 2020). Overall, the group of airports represented in Fig. 2 (including the one in Bogotá) manages 99 % of the country's domestic air traffic (Aerocivil, 2020), which guarantees a significant number of regional airports for the research.

Colombia concentrates all its population, economic and productive development in the central, western and northern regions of the country (Díaz Olariaga and Carvajal, 2016). For this reason, the airport network, and especially its main airports, are also concentrated in these regions; ultimately, the geography of the airport system and its development coincide and are consistent with the socio-economic geography of the country. However, as can be seen in Figs. 1 and 2, there are airports in remote, peripheral and isolated regions in locations other than those mentioned above where small and medium-sized communities live, which is why the presence of airports is justified, mainly small or very small.

4.2 Development of air traffic

In Colombia, the growth of domestic air traffic (national passengers) as a whole (all airports) was 926 % in the period from 1992–2019 (Aerocivil, 2020). Now, as can be

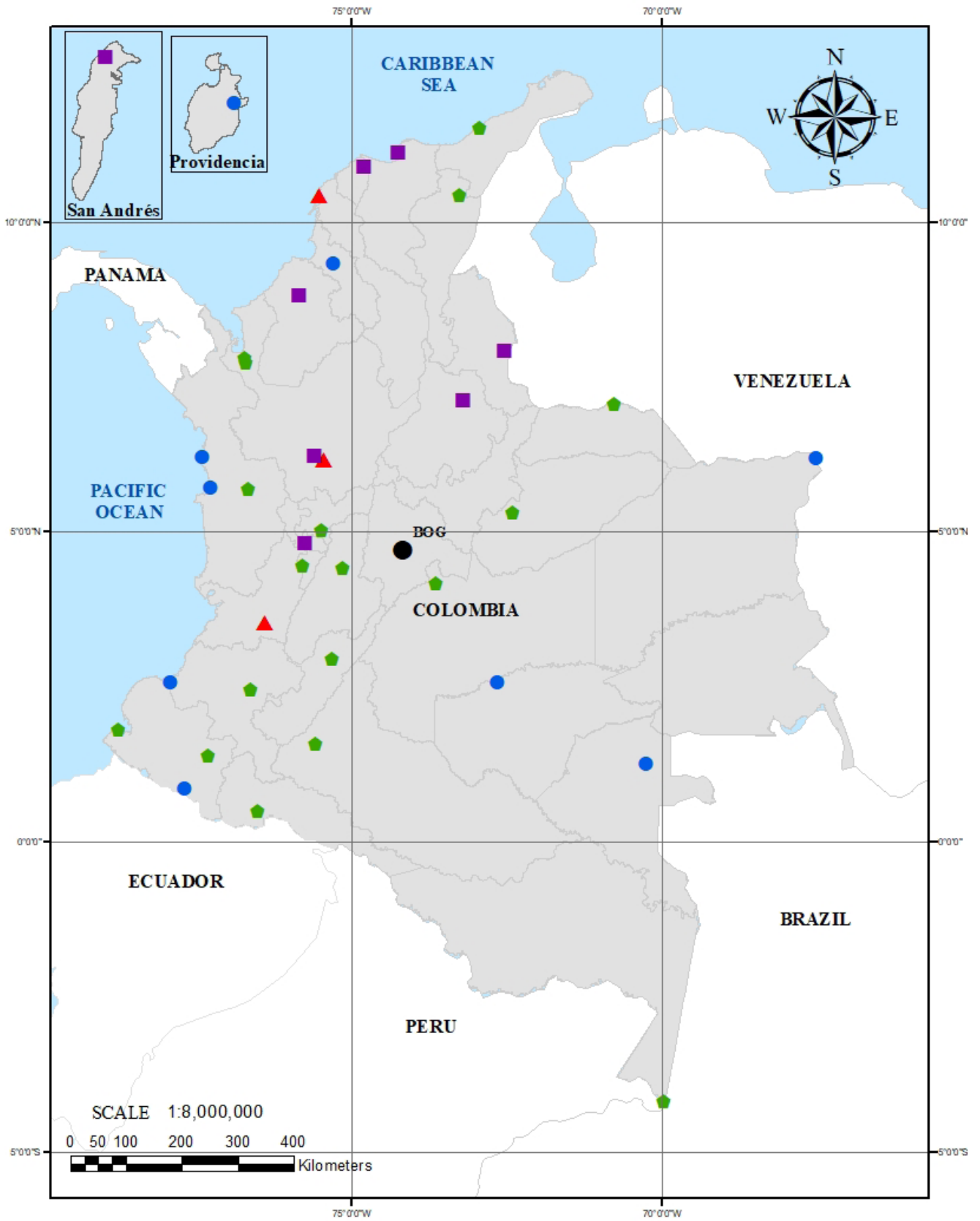


Fig. 2 Airports with traffic up to 2019. *Description:* red triangle: 4–8 Million Pax; purple box: 1–3 Million Pax; green pentagon: 0.1–0.5 Million Pax; blue circle: 0.03–0.1 Million Pax. Own edition based on data from Aerocivil (2020).

seen in Fig. 3, regional airports have had different growth rates, in many relevant cases, regardless of the size of the

airport, its geographical location or its status (central or remote, peripheral or isolated).

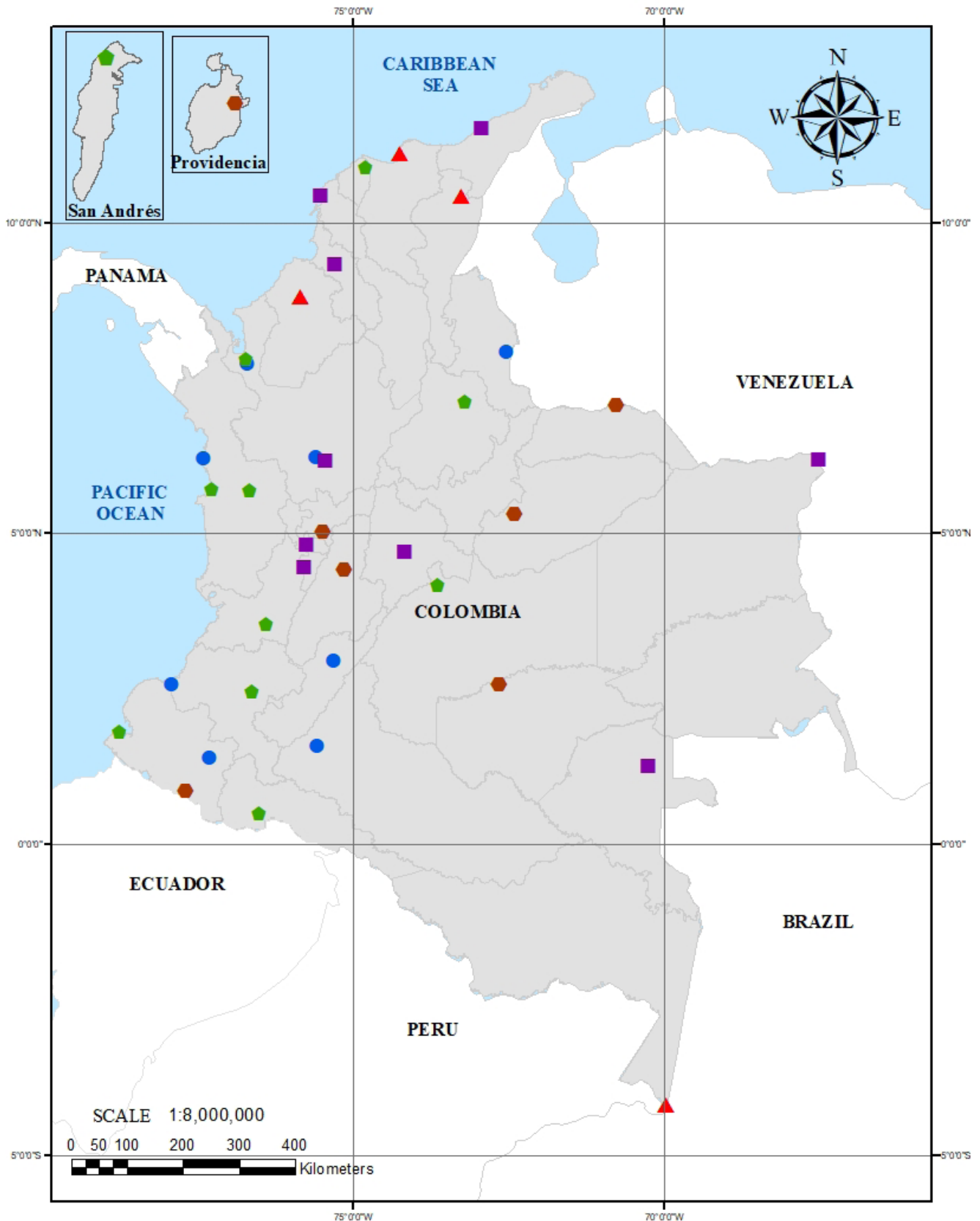


Fig. 3 Traffic growth (period 1992–2019). *Description:* red triangle: 700-1000 %; purple box: 400–700 %; green pentagon: 200–400 %; blue circle: 100–200 %; brown hexagon: < 100 %. Own edition based on data from Aerocivil (2020).

4.3 Concentration of the network, connectivity and accessibility to the regions

Recent research on the development in the last 25 years of the air transport network in Colombia at the domestic level, which used a model derived from network theory, concluded that the Colombian airport network has a weak degree of interconnection as well as a great heterogeneity (Zea et al., 2019). According to the authors, one of the most important generators of said heterogeneity is the enormous influence of the country's main airport located in its capital, which in 2019 managed 40 % of domestic traffic and 74 % of international traffic in the entire network (Aerocivil, 2020).

To determine the concentration level of domestic traffic in the Colombian airport network, the Gini Index (GI) was calculated. For the beginning of the study period (1992), one year after the start of the liberalization of air transport in the country, the result was $GI = 0.7474$; and for the end of the period (2019) the result was $GI = 0.8004$. The analysis of this indicator allows us to confirm two things: firstly, the concentration level is the usual one, and very similar to that of other regions and countries of the world in recent years and decade (Berster et al., 2015; Huber 2009); and secondly, the increase in the level of concentration is similar to that found in other air transport markets worldwide, in which the period after the liberalization of the aviation industry was accompanied by an increase in the concentration of air traffic, due to the migration from a point-to-point structure to a hub-and-spoke type (Zhu et al., 2019; Pacheco et al., 2015; Papatheodorou and Arvanitis, 2009).

Now it is interesting to know how the increase in concentration in the domestic network has influenced the flow of air traffic in the different regional destinations under study, many considered remote, peripheral and isolated. Then, the trip rate indicator that identifies the relationship between domestic passengers (arrivals and departures) managed by the airport and the population of the city or region where the airport is located was calculated. This indicator can also be considered as one kind of accessibility to air transport services, according to ICAO (2017). Table 1 shows the behavior of this indicator for the study period (1992–2019) and for all the airports analyzed. From the behavior of the indicator at least two conclusions are derived: firstly, except in three cases, the indicator grew in the airports analyzed, and in some cases significantly; and, secondly, the indicator grew in almost all destinations considered remote, peripheral and isolated (identified in Table 1 with a different typography).

Table 1 Development of the trip rate indicator in the regional destinations under study. In different typography the destinations considered remote, peripheral and isolated. Source: author.

City (Airport IATA Code)	Trip rate (1992)	Trip rate (2019)
Rionegro (MDE)	15.6	52.2
Cartagena (CTG)	0.9	4.6
Cali (CLO)	0.8	2.1
Barranquilla (BAQ)	0.5	2.0
<i>San Andrés (ADZ)</i>	<i>11.3</i>	<i>41.1</i>
Santa Marta (SMR)	0.7	4.3
Bucaramanga (BGA)	0.8	3.0
Pereira (PEI)	0.9	3.6
Medellín (EOH)	0.3	0.4
Cúcuta (CUC)	0.9	1.4
Montería (MTR)	0.3	2.0
Villavicencio (VVC)	0.4	0.9
Valledupar (VUP)	0.2	0.9
Armenia (AXM)	0.3	1.4
Quibdó (UIB)	0.6	2.7
Pasto (PSO)	0.4	0.8
<i>Leticia (LET)</i>	<i>1.2</i>	<i>6.7</i>
Neiva (NVA)	0.4	0.8
El Yopal (EYP)	3.3	1.7
<i>Riohacha (RCH)</i>	<i>0.5</i>	<i>1.3</i>
Manizales (MZL)	0.4	0.5
<i>Carepa (APO)</i>	<i>2.0</i>	<i>4.2</i>
Ibagué (IBE)	0.2	0.3
Barrancabermeja (EJA)	0.3	0.7
<i>Tumaco (TCO)</i>	<i>0.4</i>	<i>0.6</i>
Popayán (PPN)	0.1	0.4
<i>Arauca (AUC)</i>	<i>2.4</i>	<i>1.4</i>
<i>Florencia (FLA)</i>	<i>0.5</i>	<i>0.7</i>
<i>Puerto Asís (PUU)</i>	<i>0.6</i>	<i>1.7</i>
Corozal (CZU)	0.3	1.3
<i>Bahía Solano (BSC)</i>	<i>2.9</i>	<i>7.1</i>
<i>Providencia (PVA)</i>	<i>14.3</i>	<i>10.9</i>
<i>Mitú (MVP)</i>	<i>0.5</i>	<i>1.6</i>
<i>Puerto Carreño (PCR)</i>	<i>0.8</i>	<i>2.5</i>
<i>Nuquí (NQU)</i>	<i>1.3</i>	<i>2.5</i>
<i>San José del Guaviare (SJE)</i>	<i>0.5</i>	<i>0.7</i>
<i>Ipiales (IPI)</i>	<i>0.3</i>	<i>0.3</i>
<i>Guapi (GPI)</i>	<i>0.6</i>	<i>1.3</i>

In another order, ICAO (2020) established a metric to quantify the accessibility of air transport in a country and thus for the comparability with other countries and with the world average. This metric uses distance as a concept, considering that an inhabitant has access to international air transport if he/she lives within a 100 km radius of an

aerodrome that offers scheduled international direct or indirect flights. So, up to 2019, in Colombia, 54 % of the country's total population lives within the 100 km range of geographical coverage of an airport with an offer of international flights. This figure is slightly higher than the world average of 51.25 %, according to ICAO (2020).

Regarding the development of air routes, Fig. 4 shows the direct connections (point to point) and scheduled flights between all the regional airports under study and starting at 10,000 Pax/year. Now, if all the direct connections of the country's main airport (which does not participate in the study), which connects with almost all domestic destinations, are added, in 2019 there are 170 direct domestic connections, which move regular passengers on flights scheduled among all the airports in the network (Aerocivil, 2020).

Finally, it is worth a mention that recent research, in which the behavior of domestic passenger traffic in Colombia was analyzed using a gravitational model, concluded that due to factors such as the country's complex geography, the location of airports, the purchasing power of inhabitants and the lack of mobility alternatives (other modes of transport), air transport is a determining factor in inland connectivity, and where it begins to be very competitive, with respect to the road or land mode of transport, is for distances greater than 200 km (Díaz Olariaga et al., 2018).

4.4 Economic and social impact in the regions

Regarding the social effects generated by air transport in the regions where the analyzed airports are located, this research determined the following indicators: in the study period (1992–2019) there was an average annual growth in air traffic (average among all the regions under study) of 12.03 %, which was accompanied by an average annual growth of 2.08 % of the population (average between all regions) and 0.28 % of average annual growth in employment (average between all regions). These indicators are proportionally similar to those found by Tveter (2017) and Blonigen and Cristea (2015), whose research have similar approaches to the present one (regional airports, analysis in the context of liberalization, time period study, etc.) in different geographic regions.

In another order, the regional GDP per regional or domestic passenger transported quadrupled in the last two and a half decades. This behavior can be seen in Fig. 5; the regional GDP figures are the sum of all the GDP of the studied regions for each year, equal to the number of domestic passengers managed by the regional airports under study.

5 Conclusions

As the indicators presented and analyzed show, regional airports in Colombia, many of them small or very small and several located in remote, peripheral and isolated regions, have played a fundamental role in the development of the domestic air transport network, especially regarding territorial connectivity by air, and the development of the regions where airports are located.

Undoubtedly, the liberalization of the air transport sector in Colombia, which began in the early 1990s, and the continued development of public policies for the sector, as well as the policies of public and private investment in airport infrastructure that involved almost the entire airport network contributed to the progressive evolution of regional airports, and with this, to the structure of the national airport network.

Finally, it is worth mentioning that this research attempted to fill a huge gap in the scientific literature, regarding the role of regional airports in the Latin American subcontinent. In Latin America many countries have continental dimensions and have remote, peripheral and completely isolated territories from large cities, or even from the continental masses of countries. In this subcontinent the role and importance of regional airports in connectivity and territorial cohesion and in the socio-economic development of the regions will increase with great probability, which invites to continue with this line of research.

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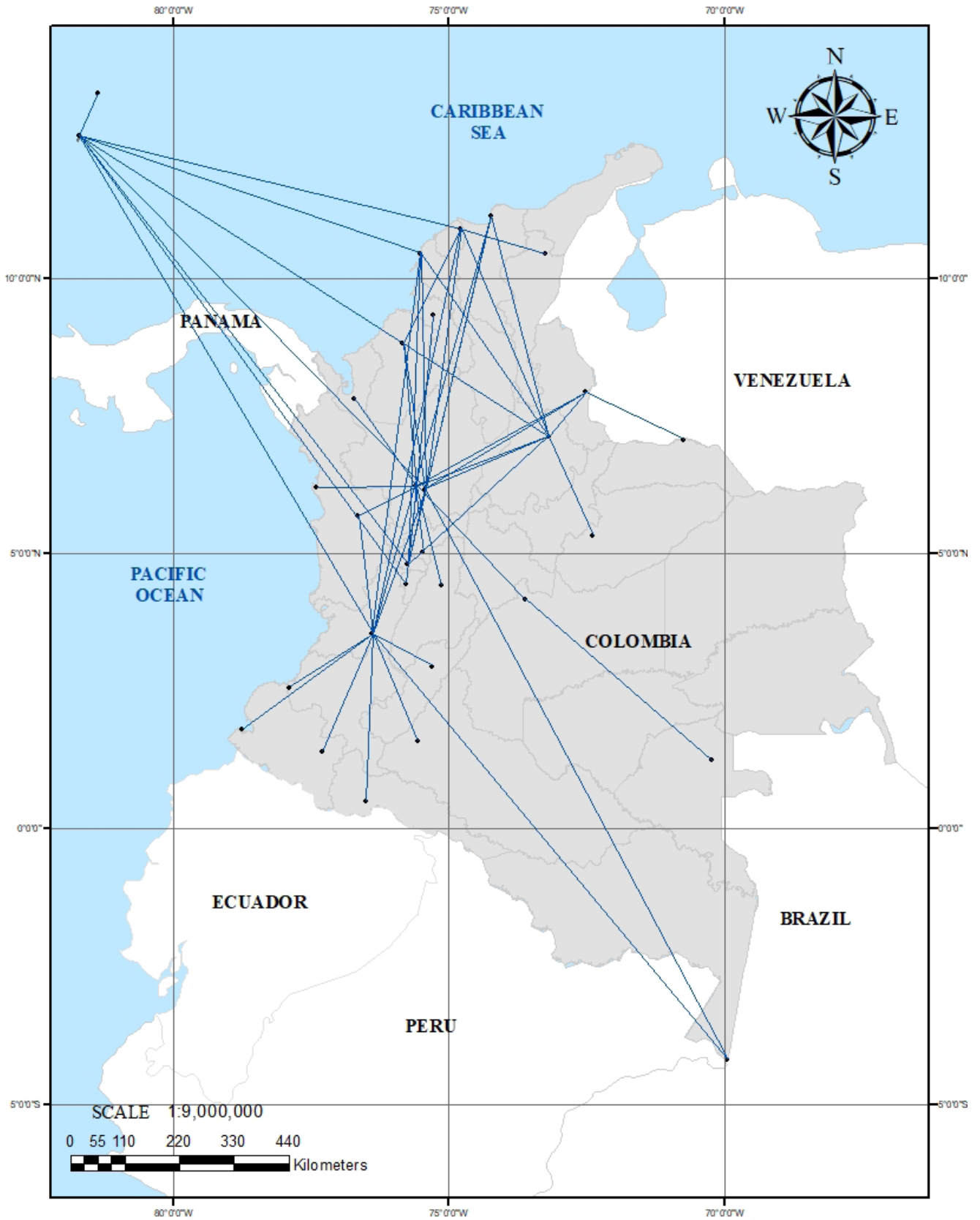


Fig. 4 Map of domestic routes, point-to-point connections, of the regional airports under study (from 10,000 Pax / year). Own edition based on data from Aerocivil (2020).

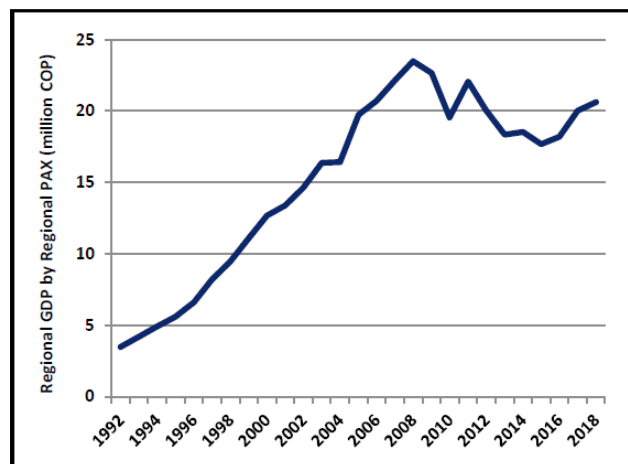


Fig. 5 Regional GDP per regional passenger transported. GDP is in current prices (COP). Own edition based on data from Aerocivil (2020) and DANE.

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