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Sustainable Development Initiatives in the Aviation Industry in Latin America: Focus on Brazil

by

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The attached Occasional Papers have been prepared by a group of scholars associated with the Institute of Air and Space Law (IASL) at McGill University. They are the result of a collaborative effort between the IASL and the Centre for International Sustainable Development Law and are designed to be part of a book prepared by authors from both groups which will eventually be published by the Cambridge University Press under the title *Sustainable International Civil Aviation*.

As the title of the book suggests, bringing together these various scholars and papers is the central theme of the sustainable development of international aviation. In particular, the work of the International Civil Aviation Organization (ICAO), the primary United Nations body tasked with regulating the environmental aspects of international aviation, and the provisions of the Chicago Convention which lays down powers of the Organization and the fundamental rules of international air law, form the primary focus of this collection. At the next ICAO Assembly in September-October of 2016, ICAO has the ambitious mandate to finalise a global scheme to limit CO2 emissions from international aviation. As many of the articles contained in the book are of immediate relevance to the discussions due to take place at ICAO, publishing and disseminating these draft chapters will contribute to the growing interest and debates on the issue of the environmental impact of aviation. It is hoped that these papers will contribute to the work of the Assembly and that informed readers and delegates participating at the ICAO Assembly will have constructive comments to share with the authors.

Readers are invited to send their comments to the authors whose e-mail addresses are set out on the title page of each paper as well as a copy to the following address: edannals.law@mcgill.ca

The authors and the Editors of this collection of papers thank all readers for their attention and their comments.

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SUMMARY

Flight management in Latin America and the Brazilian experience with its sustainable solutions to airport operations: What is the Latin American approach to sustainable airport operations?

The issue:

- How does Latin America implement flight management?
- How does Brazil address environmental issues related to airport operations?

Its importance:

- Aviation is responsible for 1.2 million jobs in Latin America and the Caribbean.
- These numbers will increase since the aviation industry is rapidly growing: passengers are expected to triple by 2030.
- This growth will also have impact on the environment, and may adversely affect the region.

The treaty law:

- Annex 16 to the Chicago Convention addresses environmental concerns posed by aviation such as aircraft noise and greenhouse gas emissions.

The analysis:

- Air Traffic Management in Latin America, particularly Performance Based Navigation, has been effective in reducing emissions and noise pollution from aircraft.
- The environment management system of Brazil, through its public company INFAERO, is divided into three areas of implementation: (1) licensing and implementation of airports in accordance with the Brazilian environmental legislation; (2) sustainable operations; and (3) environmental education.
- Most of the programs are still on the stage of establishing methodologies and studies.

Options for decision-makers:

1. Governments may further the methodologies and studies in Latin America to achieve a balanced approach to aviation.
2. Government may invest in infrastructure that supports, and is consistent with, the environmental programs implemented in Latin America.
3. No action on the matter, which may cause significant negative impact on the environment.

SUSTAINABLE DEVELOPMENT INITIATIVES
IN THE AVIATION INDUSTRY IN LATIN AMERICA:
FOCUS ON BRAZIL

by

Juliana Scavuzzi & Maha Mousavi Sameh*

I. INTRODUCTION

Air transport is an important source of economic growth in Latin America.¹ Considering the total amount of direct, indirect and induced impacts, at present aviation is responsible for 1.2 million jobs in Latin America and the Caribbean. It is believed these numbers will increase since the aviation industry will grow rapidly in the next 20 years: passengers are expected to triple by 2030.²

However, this growth will also impact the environment and it may adversely affect the region.³ Therefore, these figures also represent the challenges the region will face in order to promote a sustainable development of the air transportation industry. The need to invest in infrastructure and in the implementation of policies and regulations that enable and promotes the protection of the environment is essential in this process.⁴ Since

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¹ "For example, in Brazil, in 2009, aviation directly contributed 138,000 jobs (0.1% of employment) and made a value-added contribution to GDP of BRL 13.3 billion (0.4% of GDP). In addition, regional economies derive substantial benefits from the spending of tourists travelling by air. Including this catalytic impact and the indirect and induced impacts of aviation activity increases the impact of aviation on GDP in Brazil to BRL 42 billion (1.3% of GDP)." In *Aviation beyond Borders*, 29

² The size of the air transportation industry can be expressed through the amount of \$ 48 billion it contributes to GDP in the region. The Latin America and the Caribbean accounts for 8% of the total jobs and 5% of the GDP generated worldwide by the industry. Oxford economics also predict that the direct impact aviation is able to generate to GDP in the region is going to increase 6.4% every year, if it is considered the same 20 years period. This will help to produce around 329,000 jobs in the region. In *supra* 1.

³ "Aviation is a small but important contributor to climate change. ICAO/CAEP's initial estimate is that the total volume of aviation CO₂ emissions in 2006 (both domestic and international) is in the range of 600 million tonnes. At present, aviation accounts for about 2% of total global CO₂ emissions and about 12% of the CO₂ emissions from all transportation sources In ICAO Environment Report

⁴ "In a region where deficiencies in infrastructure are highlighted as an important factor stifling economic growth, improvements in air travel are crucial for business growth and helping people and goods to move around more easily. Unlike North America and Europe, where one can board a high-speed train or a relatively quick flight, there is no easy way to travel around Latin America where options are confounded by large distances and uncompromising geography. Buses are the most common form of transportation within and between Latin American countries. Although much cheaper than air travel, bus rides can last days and be both uncomfortable and dangerous, making flying a better option for those who can afford it."

these countries face economic difficulties it is important to balance sustainable approaches with the economic reality to promote the adequate scenario to the industry to growth properly in the region.⁵This chapter will focus on the flight management in Latin America and the Brazilian experience with its sustainable solutions to airport operations.

II. FLIGHT MANAGEMENT IN LATIN AMERICA

Due to the growing number of flights in the region, greenhouse gas emissions and fuel consumption have become a concern. Through flight management it is possible to better distribute the airspace and help to straighter routes and shorter flight time, which in turn will consume less fuel and produce less greenhouse gas emissions.

A. PBN IMPLEMENTATION IN THE CARIBBEAN AND SOUTH AMERICA

The air navigation planning using performance based operations can give rise to an increase in flight efficiency as well as the mitigation of emissions and noise, through the use of more direct routing, preferred trajectory, parallel offsets, reduction separation and more flexible procedures design capabilities. PBN has been introduced globally and it is supported by ICAO.⁶CAR/SAM States have created the PBN Roadmap⁷ for the region

In Aviation takes off in threatening climate, see online: Suzy Mage and Guy Edwards, "Aviation takes off in threatening climate, *Thomson Reuters Foundation* (14 November 2012), online: Thomson Reuters Foundation <www.trust.org/item/?map=aviation-takes-off-in-threatening-climate/>.

⁵ *Supra* 1.

⁶ PBN Implementation Kit. International Civil Aviation Organization (ICAO).

⁷ According to ICAO, CAR/SAM PBN Roadmap is a

document offering appropriate guidance for air navigation service providers, airspace operators and users, regulating agencies, and international organizations, on the evolution of navigation, as one of the key systems supporting air traffic management, which describes the RNAV and RNP navigation applications that should be implemented in the short, medium and long term in the CAR/SAM Regions.

Area Navigation (RNAV) is defined as

a method of navigation which permits aircraft operation on any desired flight path within the coverage of ground or spaced-based navigation aids or within the limits of the capability of self-contained aids, or a combination of these. Note.— Area navigation includes performance based navigation as well as other operations that do not meet the definition of performance based navigation.

Performance based navigation (PBN). Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace. Note.— Performance requirements are expressed in navigation specifications in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept. Navigation specification. A set of aircraft and air crew requirements needed to support performance based navigation operations within a defined airspace. There are two kinds of navigation specifications:

RNP specification. A navigation specification based on area navigation that includes the requirement for performance monitoring and alerting, designated by the prefix RNP, e.g. RNP 4, RNP APCH.

RNAV specification. A navigation specification based on area navigation that does not include the requirement for performance monitoring and alerting, designated by the prefix RNAV, e.g. RNAV

with the assistance of some organizations like the International Air Transport Association (IATA), the International Federation of Airline Pilots' Association (IFALPA) and the International Federation of Air Traffic Controllers' Association. The Roadmap will provide assistance for to air navigation service providers, airspace operators and users, regulatory agencies, and international organisations, in order to help them planning and defining their investment strategies while they overcome the difficulties that may rise in the implementation process.⁸

Considering the growth of the use of air transportation in the CAR/SAM region, PBN is an important tool to overcome the limitations of the airspace capacity that may appear in some areas. Flight time is reduced with the introduction of optimal flight paths and this is responsible for savings in fuel and in greenhouse gas emissions as it may also reduce noise in some urban areas with the new descend approaches. RNAV and RNP also enhance airport and airway arrival routes in adverse weather conditions and they are able to clear critical obstacle and to meet environmental requirements, such as the allowed level of noise in a specific region and the consumption of less gas during take-off and landing procedures. The last is also possible through more precise approaches, which deals with congestion in busy airports, reducing delays. Congestion means airplanes in the sky waiting for clearance to land, burning gas and polluting the atmosphere; this reduction in delays are also possible due to the implementation of new parallel routes and new arrival and departure points.

Many important ATM advances have been made to implement PBN in Latin America. For instance, GE Aviation and LAN performed the first region flight in Latin America using precise PBN procedures from Cusco (Peru) to Lima (Jorge Chavez International Airport) in 2012.⁹ In August 2014, Avianca Airlines and Airbus Prosky conducted a flight demonstration showcasing the implementation of Required Navigation Performance arrivals and approaches at Monseñor Óscar Arnulfo Romero International Airport, located 50 km from San Salvador.¹⁰ In Mexico, the first PBN

5, RNAV 1.

⁸ The objectives of the Roadmap were established, in order to promote only necessary, but detailed technical requirements, making the interoperability possible while avoiding commercial interests to make the implementation too expensive: to guarantee that the implementation of the navigation aspect of the CNS/ATM concept is done through a clear established operational requirements; to focus on the necessary equipment on board and systems on the ground to avoid unnecessary investment and interoperability concerns; to prevent several different airworthiness and operational protocols for intra and inter-regional operations; to preclude commercial interests from exceeding ATM operational requirements, which would increase the costs of implementation and operation for CAR/SAM States, International Organizations, and even for airspace users; and finally to elucidate every single aspect of the contents of the CAR/SAM Air Navigation Plan and of the CAR/SAM CNS/ATM Plan, defining possible navigation applications. In ICAO CAR/SAM Roadmap for Performance Based Navigation, at Executive Summary item 1.2/1.3.

⁹ Bill Carey, "Chile's LAN Conducts Region's First Performance-Based Flight", AIN Online, (19 March 2012), online: AIN Online <www.ainonline.com/aviation-news/air-transport/2012-03-19/chiles-lan-conducts-regions-first-performance-based-flight>.

¹⁰ "Airbus Prosky and Avianca complete successful Performance Based Navigation flight from El Salvador International Airport", Airbus (Press Release, 4 August 2014), online: Airbus <www.airbusprosky.com/news/press-releases/566-airbus-prosky-and-avianca-complete-successful-

procedures initiated at Toluca International Airport in 2010, but recently efforts to deploy PBN operations in Tijuana and Guadalajara airports have been announced.¹¹

PBN procedures between Cuzco and Lima, in Peru, are able to save 19 track miles, 6.3 minutes of flight time, 200 kg of fuel and 640 kg of CO₂ emissions per flight. In Brazil, the SIRIUS program has been implementing PBN procedures since 2012. It is responsible for considerable noise reduction through stable descent trajectories and reduction of approximately 203,000 metric tons of jet fuel or 640,000 tons of CO₂ per year. These results are achieved based on the implementation of the Collaborative Decision Making (CDM) process, which involved over 1,000 personnel from different stakeholders.¹²

The CAR/SAM region however, does not have the same level of airspace congestion as Europe or North America. Therefore, the cost-benefit approaches in the region are essential, in order to make them successful, since there is not the same need to cope with congestion. However, some airports, for example, have already reached their capacity and in the future others might have a similar reality. This is the case of some Brazilian airports that will be shortly identified when this chapter analyses Brazilian airports sustainable operations.¹³

III. BRAZILIAN SUSTAINABLE APPROACH IN ITS AIRPORT OPERATIONS

A. INTRODUCTION

Brazil is a developing country of continental dimensions. Therefore, aviation plays an important role in connecting the country and it has an important impact in its economy. The investment in the aviation infrastructure is as essential to transform Brazil as it is to promote this investment through a sustainable approach. This chapter describes

performance-based-navigation-flight-from-el-salvador-international-airport.html>.

¹¹ Woodrow Bellamy III, "Volaris, ALTA Working to Expand PBN in Latin America", *Avionics* (24 August 2015), online: Aviation Today <www.aviationtoday.com/av/commercial/Volaris-ALTA-Working-to-Expand-PBN-in-Latin-America_85870.html#.VeO0G_IVhBc>.

¹² ICAO Air Navigation Report 2014, online: ICAO <www.icao.int/airnavigation/documents/icao_an%20report_en_final_30042014.pdf>.

¹³ The experts realized it would be impossible to create a single PBN implementation plan for en-route operations as well as a single specification for RNV and RNP in the entire CAR/SAM region. Since the area is already structured with different realities, it would become too complicated to achieve a single application. Therefore, the solution was the operation of PBN by different routes/areas in CAR and SAM realities, in accordance to their own concepts and infrastructure capabilities. This may include a group of States/ Territories and International Organizations that will implement it themselves. Depending on the form these agreements between states/territories or international organizations are done, there a few legal issues that could rise, especially if exists any delegation of ANS from one state to another. According to technical requirements, it may become easier to a state to delegate its ANS in order to facilitate the interoperability of a determined route/area. This could affect the liability of the air navigation service provider, which is normally a state responsibility, according to the Chicago Convention, article 28. In Chicago Convention, article 28

the sustainable program of the INFRAERO.¹⁴

The INFRAERO's environment management system is divided among three areas of implementation: first, the licensing and operation of airports in accordance with the Brazilian Environmental legislation; second, the sustainable operations, through the either the efficient use of the natural resources or the reduction of costs and environment impacts of its activities while improving the productivity level of the business; the third is focused on the environmental education of its employees and community, in order to make them sensitive and concerned with the problem.¹⁵

B. SELECTIVE WASTE COLLECTION

The Decree n. 5.940/2006 established the Solidary Selective Waste Program in the country. It determined that the recyclable waste generated from any federal administration entity must be selected and distributed to the associations and cooperatives of recyclers. These organizations must be formed legal and exclusively from recyclers who do not have other financial resource, but recycling; they may not pursue profit; they must provide the necessary infrastructure to separate and classify the recyclable waste; they must have a system to share the earnings with its associated and cooperated.¹⁶ It is an interesting program who incentives the recycling activity and at the same time help the less fortunate who live solely from this activity. It is believed there are around 1 million recyclers in Brazil, but only 40 to 60.000 are organized through 1.175 entities in the country.¹⁷

INFRAERO started officially its selective waste collection program after the decree in 2009. It elaborated a guidebook "Recycle your Concepts" and the necessary materials to develop the initiative.¹⁸

The program is fortunate as it can promote both the sustainable approach regarding the environment and assistance of the community of recyclers. The challenge is the inclusion of a great number of recyclers in the country who do not belong to any institution. Since they need to be part of these cooperatives, in order to participate in the program, government partnerships with different organizations should be established in

¹⁴ INFRAERO is a national public company, linked to the Ministry of Defence and that manages most of the Brazilian airports - 63 - and which represent 97% of the Brazilian regular air transport traffic. In INFRAERO website: <www.infraero.gov.br/index.php/br/meio-ambiente.html>.

¹⁴ *Supra* Note 1.

¹⁵ *Supra* Note 1.

¹⁶ Decree 5.940, online: Presidencia da Republica <www.planalto.gov.br/ccivil_03/_Ato2004-2006/2006/Decreto/D5940.htm>.

¹⁷ Online: INFRAERO <www.brasil.gov.br/noticias/arquivos/2013/06/05/trabalho-de-catadores-de-materiais-reciclaeis-e-tema-de-seminario..>.

¹⁸ INFRAERO Meio Ambiente. A implantação da coleta seletiva na INFRAERO, online: INFRAERO <www.infraero.gov.br/index.php/br/meio-ambiente/coleta-seletiva.html>.

order to facilitate this process. INFRAERO should be involved in this cooperation.

C. LICENSING PROGRAM

The INFRAERO's Environment Licensing Program aims to assure all airports it operates are in accordance with the Brazilian Environment Law. Therefore, the objective is to license and to maintain the operational licenses to its airports, including the license to any reform needed. Due to the different expertise needed to grant the license proceeding, several specialists from different areas are involved in this process.¹⁹

D. RESIDUE PROGRAM

INFRAERO has also a Program for Solid Waste Management. The concern is to obey the environment legislation and to promote the best practices, in order to reduce pollution while it is also developed a cost-benefit approach to adequately handle the solid waste generated by airport operations. There is also the objective to protect the population from residues that come from endemic or suspected of infectious diseases areas. This operation is provided with the support of the bodies that provide surveillance and sanitary control at Brazilian international airports. Infectious diseases such as H5N1 and H1N1 influenza are a serious concern.²⁰

E. WATER RESOURCES PROGRAM

Brazil has a great amount of its surface covered by fresh water coming from river and lakes: 50.000m².²¹ Sustainable management is essential to such a great source of natural water reservoirs, in order to avoid pollution and contamination. However, the economic impact of water quality degradation in the country is not completely known: according to the Brazilian National Water Agency, "the environmental and social impacts of water quality degradation have economic reflexes which are not always measured, such as higher costs for treating water intended for domestic supply and industrial use, higher hospital costs as a result of waterborne diseases loss of productivity in agriculture and livestock, reduction in fishery and loss, of biodiversity and tourist, cultural and landscape assets."²²

¹⁹ INFRAERO - Programa de Licenciamento, online: INFRAERO
<www.infraero.gov.br/index.php/br/meio-ambiente/programa-licenciamento.html>.

²⁰ INFRAERO - Residue Program, online: INFRAERO
<www.infraero.gov.br/index.php/us/environment/residue-program.html>.

²¹ Moreira, José Roberto. Water Use and Impacts Due Ethanol Production in Brazil, online:
<www.iwmi.cgiar.org/EWMA/files/papers/Jose_Moreira.pdf>.

²² Surface Freshwater Quality in Brazil. Outlook 2012 at 58, online:
<arquivos.ana.gov.br/institucional/sge/CEDOC/Catalogo/2012/PanoramaAguasSuperficiaisIngles.pdf>.

Some airports can be compared to cities due to the number of people who use it. Regarding its water consumption is no different.²³ The daily consumption of water at large airports such as the São Paulo International Airport can affect the supply in the area where they are located.²⁴ It is the biggest airport in Brazil and second in Latin America. It is like a medium size city regarding water consumption. It has approximately 17 million passengers a year and it consumes an average of 658.000 m³/year (average from 2000-2008)²⁵. It captures this water from nine artisan wells. It is also affirmed that one of the elements that limits the possibility of airport expansion is the need for water, since most of the big airports are localized in regions with low water sources, like the airports in São Paulo, which is one of the most populated regions in the world: its metropolitan area has over 17.8 million inhabitants. This region does not have a sufficient public water supply and it needs to “import” from close regions like the Piracicaba River.²⁶

According to a study promoted by the Brazilian Institute of Technology (ITA) if the airport re-uses the water from the rain, 40% of the rain water would be enough to cover 100% of its consumption. Therefore, it is necessary to establish a system to treat the water and to create regulation to settle the standards. However, since there are times with no rain, it is also necessary to keep other sources of water as well for those times.²⁷ H2C Consulting promoted a study to analyse the toilets’ water consumption at Brazilian airports that received World Cup games in 2014. It defended that the reduction on water consumption at these airports could have reached 70%. According to the study, Cuiabá airport in Mato Grosso presented the greatest potential margin to improvement and Recife International airport was the closest to the ideal consumption.²⁸ Although there is no study showcasing the results of the potential saves in water consumption at these airports were reached during the World Cup in 2014, it is worth to mention that the water consumption in Sao Paulo during the games was increased by 26% of all clients of the metropolitan region.²⁹

²³ Jim Tharpe, “Airport hoping to flush away less water” *The Atlanta Journal-Constitution* (29 October 2007), online: <www.accessmylibrary.com/article-1G1-170436191/airport-hoping-flush-away.html>.

²⁴ E. N. Ribeiro et all. Stormwater usage in airport plants: case study at São Paulo International Airport, online: <www.hidroaer.ita.br/PDF/HIDROAER_RelatorioFinal_Anexo_29.pdf>.

²⁵ Ribeiro, Elaine Nolasco et all. Diagnóstico do uso da água no aeroporto internacional de São Paulo através de monitoramento remoto do consumo, online: <www.hidroaer.ita.br/PDF/HIDROAER_RelatorioFinal_Anexo_32.pdf> Cita INFRAERO 2007>.

²⁶ *Supra* note 25.

²⁷ Elane Nolasco Ribeiro et all. PROPOSTA DE DESENVOLVIMENTO SUSTENTÁVEL PARA O AEROPORTO INTERNACIONAL DE SÃO PAULO ATRAVÉS DA CAPTAÇÃO E APROVEITAMENTO DA ÁGUA DE CHUVA at 12, online: <www.abcmac.org.br/files/simpósio/7simp_nolasco_proposta.pdf>.

²⁸ Aeroportos brasileiros desperdiçam água, online: <www.portal2014.org.br/noticias/7178/AEROPORTOS+BRASILEIROS+DESPERDICAM+AGUA.html>

INFRAERO response to the study (press release), online: <www.infraero.gov.br/index.php/us/press/notes-and-answers/4443-nota-a-imprensa-uso-de-agua-e-banheiros-nos-aeroportos-da-infraero.html>.

²⁹ Na Copa, 26% elevam consumo de água em São Paulo, online: <sao-paulo.estadao.com.br/noticias/geral,na-copa-26-elevam-consumo-de-agua-em-sp,1535324>.

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FOCUS ON BRAZIL

Recife International Airport was projected and constructed according to an environmental friendly approach: the water that evaporates at its refrigeration system is used in toilets. Besides, its vacuum sewer saves 30% on water consumption at the airport. Translating it to numbers, the airport consumes 21.400 m³/month of water instead of 30.600, which is considered a valuable saving source.³⁰

Rio de Janeiro International airport is another example of good practices: due to the transformation of the water and sewer system and the implementation of alternative sources of water, the airport is capable of producing 70% of the water it consumes. From 2001 to 2009 it reduced its consumption in 40% while its passengers almost doubled (98%). The airport is the first in the country to use a technology to re-use the water through the system of inverse osmosis. Besides, it re-uses also water from rain and it explores the subterranean water system.³¹

The INFRAERO's Water Resources Program aims to promote the rational use of the water. Therefore, it targets consumption, trying to reduce it either through optimization of the water use or using technologies to build new sites, in order to create an infrastructure adequately constructed to promote the reduction on water consumption. There is also the objective to protect watershed, springs and watercourses from the polluting operation of airports.

INFRAERO made partnerships with different sectors such as the education and governmental institutions in order to promote new projects to develop the rational use and conservation of water in airports.³² It has also signed a cooperation agreement with the Brazilian National Water Agency (ANA) to promote water resources at Brazilian airports and to create campaigns to educate and make public the joined effort in reducing water consumption.³³

It is also worth mention the environmental requirements present at any reform or construction at airports which have adopted guidelines for the reduction on water consumption; the reuse of rainwater for specific needs; and the evaluation of the possibility to recycle, treating effluent for non-potable purposes.³⁴

³⁰ Op cite, note 14.

³¹ Gestão sustentável dos recursos hídricos no aeroporto do Galeão, online: <blog.ambientebrasil.com.br/2010/05/gestao-sustentavel-de-recursos-hidricos-no-aeroporto-galeao-rj/>.

³² One example is the Public Call MCT/FINEP/CT-HIDRO: it was announced by the federal government, the Ministry of Science and Technology, through its financial institution FINEPE in 2005. According to Law n. 9.993 of 24/07/2000 and Decree n. 3.874 of 19/07/2001, FINEPE was in charge of the implementation of the Hydric Resources Sectorial Fund (CT HIDRO) to financially support projects that promote the rational use and conservation of water used in airports. The projects should be developed by scientific and technological institutions or other educational and institutions focused on the research of the hydric resources. Twelve institutions were selected in 2010 as a result of the public call to develop the projects.

³³ INFRAERO website.

³⁴ *Ibid.*

F. SOILS AND FLORA PROGRAM

The construction and expansion of the airports infrastructure usually requires changes in the soil and it adversely impacts the environment, causing different types of erosion. INFRAERO Soils and Flora Program aims to restore and promote the environment balance which is affected by its operations, developing studies and using new technologies and low cost materials that are found in the area and re-used, such as remains of work. Studies regarding the airports effect on soil and flora in airports areas are an important source to determine and minimized this impact. INFRAERO has an agreement with a Brazilian agricultural stock-breeding research company (Embrapa Solos) in order to mitigate the problem through the implementation of technical and financial cooperation.³⁵ The focus of the partnership is to promote the recuperation of the degraded area, to develop organic fertilizers from the cut lawn and to monitor the environment, in order to establish the quality of soil, water and carbon.³⁶ It is worth mention the composting pilot unity that was implemented at the Rio de Janeiro International Airport, at its lawn area, in order to produce organic fertilizers. Besides the fact that this program gives a best destination to the waste generated by the maintenance of lawn, it creates a good quality organic input, which is considered to be a limited resource in urban areas and they can be well used in parks and gardens.³⁷ The program is considered such a success that it has already been introduced to another 19 airports in the country. The next step is to promote studies to plan the agricultural use of airport commercial areas taking into consideration safety and security standards at airports, in order to establish programs that that are able to while promoting the sustainable environment, they generate income and economic alternative to the less fortunate families in the country.³⁸

G. ENVIRONMENT RISK PROGRAM

The objective of this program is to prevent, to control and to mitigate any harmful contamination of the environment and the people caused by inappropriate packing, transport, handling and use of dangerous goods. The program reaches a wide selection of activities in order to avoid accidents and improper handling of harmful material. INFRAERO keeps a data center to manage the information that comes from the program, in order to decide its actions. The most important control regards the airplane fuel supply, systems that require the manipulation of liquefied gas, stocking of dangerous goods, rainwater drainage and cooling systems. INFRAERO also promotes the separation of water and oil in different areas such as the runways, the aprons, fuel supply and

³⁵ INFRAERO website: Soils and Flora Program, online:
<www.cnps.embrapa.br/noticias/banco_noticias/010805.html>.

³⁶ Embrapa website, online:
<www.embrapa.br/imprensa/noticias/2006/setembro/1%20semana/noticia.2006-09-06.8818797044/#>.

³⁷ Online: <www.cnps.embrapa.br/noticias/banco_noticias/010805.html>.

³⁸ Op cit, foot note 27.

maintenance regions.³⁹

H. INFRAERO'S NOISE PROGRAM

Noise is one of the most negative impacts airports operations have on the environment and it directly disturb its users, employees and mostly the communities who live close. Noise reduction is a concern at Brazilian airports and there are regulations in place to monitor and to control the amount of noise that is allowed at different airports.

INFRAERO focus its noise program in the reduction of noise at the original source, the management of take-off and landing procedures to make them adaptable to the regions where the airport is located, the restriction of airport operations at specific times and the monitoring of the land occupation's oversight around airports, which is competence of the municipal authority. INFRAERO admits the greater sources of noise, besides airplane operations, is the ground equipment that gives support to aircraft procedures. Therefore, it promotes partnerships with research institutes and specialized companies in order to find alternatives to deal with the problem. The studies address the economic and technical aspects of the substitution of auxiliary equipment on the ground for fixed unities. Besides it is also promoting noise campaigns at critical airports and training employees to be able to identify and to monitor the noise in order to reduce it.⁴⁰

Regarding new routes, the Brazilian Department of Airspace Control in partnership with Gol Airlines and GE Aviation has established new approaching and landing procedures to Santos Dumont airport in Rio de Janeiro in 2012. The new route uses satellites to guide the airplane into a precise and continuous descend procedure, which are able to reduce time and noise during operations.⁴¹

INFRAERO has been implementing a modern noise monitoring system at Brasília and Guarulhos International airports. It will make possible to identify the commercial flights that most impact the community with its noise operations in order to fulfill the national aviation authorities with information to proper address the problem through regulation and alternative routes and procedures to minimize this negative impact.

The Brazilian National Aviation Authority (ANAC) implemented the Airports Noise Zoning Plan (PZR) through the Regulation of the Brazilian Civil Aviation (RBAC 161; ANAC Resolution 202/2011).⁴² According to this regulation, any Brazilian

³⁹ INFRAERO website. Environment Risk Program, online:

<www.infraero.gov.br/index.php/us/environment/environmental-risks-program.html>.

⁴⁰ INFRAERO website: Noise Program, online: <<http://www.infraero.gov.br/index.php/br/meio-ambiente/programa-ruído.html>>.

⁴¹ The proceeding was established in accordance with the Brazilian CNS/ATM implementation and it is only possible to aircraft and crew that have been certified by the Brazilian National Civil Aviation Authority (ANAC). In Menos Ruído e mais capacidade: <www.decea.gov.br/2012/05/07/menos-ruído-e-mais-capacidade-decea-inaugura-novos-procedimentos-de-aproximacao/>.

⁴² A PZR is a document elaborated according to the mentioned RBAC rules and it is able to geographically

aerodrome must have a PZR and it has to be registered at ANAC. It also defines the criteria that airports should follow regarding their noise operations. Aerodromes that have had an average over the last three years of more than 7.000 aircraft have to conform with a Specific Airport Noise Zoning Plan (PEZR). All the others may choose between a Specific and a Basic Airport Noise Plan (PBZR). However, if ANAC decides any aerodrome should comply with a specific plan (PEZR), it may demand it. The Basic Plan differs from the Specific because the last one includes noise curves of 85, 80, 75, 70 and 65 dB while the first one is restricted to 75 and 65 noise curves.⁴³

The greater challenge is present at the following Brazilian airports: Guarulhos International Airport (São Paulo), Recife International Airport, Rio de Janeiro International Airport and São Paulo Airport (Congonhas). These four airports are considered to have the greatest noise impact at the surrounding community, according to a research that took into consideration 36 airports and three factors: noise curve area, population living inside the noise curve area and airport operations at night.⁴⁴ Guarulhos is considered to be the worst among all studied airports in all three categories. It is relevant to observe that Congonhas airport already has its operations restricted from 10:00 PM to 07:00 AM, and they are prohibited from 11:00 PM to 06:00 AM. However, the number of flights is still expressive enough from 06:00 to 07:00 and from 10:00 to 11:00 PM to keep the airport at its 4th position among the 36 airports that were part of the analyses.⁴⁵

I. WILDLIFE PROGRAM

In Brazil, the number of flights that have collided with birds has been increasing in the last five years. The reported cases in 2008 were 659 while in 2012 there were 1668 reported occurrences.⁴⁶ INFRAERO has its own wildlife program and interestingly it has been able to involve the community around airports to help dealing with the problem. The community that lives close to airports has been taught to properly shoot the dead birds involved in collision with aircrafts, in order to create a data base of the type of birds

represent the aeronautical noise impacted areas from aerodrome operations, in order to promote its harmonic operations with the community who lives around it. In Free author's translation: ("Plano de Zoneamento de Ruído de Aeródromo - PZR: documento elaborado nos termos deste RBAC, que tem como objetivo representar geograficamente a área de impacto do ruído aeronáutico decorrente das operações nos aeródromos e, aliado ao ordenamento adequado das atividades situadas nessas áreas, ser o instrumento que possibilita preservar o desenvolvimento dos aeródromos em harmonia com as comunidades localizadas em seu entorno.) In RBAC 161; ANAC Resolution 202/2011, item 1.61.1, online: <www2.anac.gov.br/biblioteca/rbac/RBAC161EMD00.pdf>.

⁴³ RBAC 161; ANAC Resolution 202/2011, item 1.61.15, online: <www2.anac.gov.br/biblioteca/rbac/RBAC161EMD00.pdf>.

⁴⁴ Nykiel, Thiago. *Análise do Impacto do Ruído Aeronáutico em 36 Aeroportos Brasileiros*. Trabalho de graduação. Instituto de Tecnologia da Aeronáutica - ITA, Divisão de Engenharia. São José dos Campos, 2009 at 50.

⁴⁵ Nykiel, Thiago, *supra* note 34 at 44.

⁴⁶ CENIPA Report of Brazilian Accidents, online: <www.cenipa.aer.mil.br/cenipa/Anexos/article/19/FCA%20581%20Estat%C3%ADsticas%20da%20Avia%C3%A7%C3%A3o%20Civil%202012.pdf>.

involved incidents and accidents in each region. INFRAERO has created a Manual to assist in this endeavour. It also made a partnership with the University of Brasilia – UNB, in order to create and implement studies and actions that can promote the reduction of the factors which attract the fauna close to airport operations. They have been monitoring the airports to better understand the situation. Besides INFRAERO approach, there is also the work of different sectors to promote the same goal: Biologists are involved in this project as well as the Brazilian civil aviation and environmental authorities.⁴⁷

J. EMISSIONS PROGRAM

INFRAERO is currently establishing a methodology to analyse the different pollutants, in order to separate the pollution of the airport site which is a result of the vehicle traffic on surrounding roads. In this sense it will be established an inventory from the data collected. The idea is to promote the monitoring of the pollutants, in order to better control and reduce them.

It has also been developing a software that is able to establish the CO₂ emissions of its fleet. It also plans to create an inventory of the atmospheric emissions and to study the dispersion of pollutants and the consequences to human health at Congonhas international airport; and to study the possibility of implementing fixed unities that can provide air conditioning, compressed air, clean water and power to aircraft that are parked.

IV. CONCLUSION

The Latin American sustainable development in aviation has to take into consideration the economic reality of the region. The cost-benefit of these approaches must be properly defined in order to balance the interests involved. As it has been demonstrated, it has still many challenges to face. Many of its programs are still based on the establishment of methodologies and studies that need to prosper in order to achieve their objectives. Besides these initiatives, the investment on infrastructure that is able to promote the results of the studies and methodologies that have been defined is essential. Moreover, this sustainable approach has also to cope with the pace of the growth of aviation in the region, in order to at least maintain its initial proposal. However, this may also become a unique challenge for the region: to expand rapidly while being environmentally sustainable. As Latin America has been developing, so must be its air transportation system and its sustainable approaches to aviation.

⁴⁷ INFRAERO website, online:
<www.infraero.gov.br/index.php/us/environment/wildlife-program.html>.

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