GUY

GUIANESE SHIELD

INTEGRATION AND DEVELOPMENT HUB

UNASUR
COSIPLAN

Socioeconomic and Environmental

Characterization

UNASUR
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SOCIOECONOMIC AND ENVIRONMENTAL CHARACTERIZATION

GUIANESE SHIELD HUB

Technical Forum IIRSA
Technical Coordination Committee

IDB CAF DEVELOPMENT BANK OF LATIN AMERICA FONPLATA

Secretariat: INTAL

Note: Document prepared by consultant Matías Parimbelli. Its content is the responsibility of its author and does not express the position of the institutions that make up the CCT or of the governments and institutions participating in COSIPLAN-IIRSA. Maps are only for referential purposes and do not reflect the official position of any of the States involved in the Guianese Shield Hub.

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EXECUTIVE SUMMARY

This report forms part of the COSIPLAN-IIRSA Strategic Action Plan for 2014-2015, which considers updating the social, economic, environmental and integration infrastructure data characterizing each one of the Hubs within the Project Portfolio, as identified by applying the Indicative Territorial Planning Methodology.

The **area of influence** defined for the Guianese Shield Hub covers a territory of 1,603,643 km^2, accounting for 9% of the total area of the South American continent. This Hub is inhabited by 17,101,205 people, representing 4.2% of the total population of South America (estimated at 405,040,460 inhabitants), thus being one of the least populated hubs in the continent. The Hub covers the total territories of Guyana and Suriname, a significant portion of Venezuela comprising the states within the Orinoco basin in addition to the Capital District of Caracas and the states on the northern coast, the whole territory of the Brazilian states of Roraima and Amapá, and a smaller area of the states of Amazonas and Pará, also in Brazil, including the municipality of Manaus, among others.

As for the **economy**, the Gross Domestic Product (GDP) of the countries' administrative units included in the Hub was estimated at US$ 338,963 million at 2014 current prices, representing 7.4% of the South American GDP for the same year, ranking seventh among that of the nine Hubs included in the COSIPLAN-IIRSA Indicative Territorial Planning. Venezuela accounts for almost 70% of the Hub's GDP; Brazil ranks second, contributing approximately 28%, a low percentage given the size of its economy, but still significant in the context of this Hub on account of its nominal magnitude. The GDP percentage contributed by both Guyana and Suriname is far lower, not higher than 3% of the total GDP of the Hub.

The Hub's **infrastructure**, according to the COSIPLAN-IIRSA Indicative Territorial Planning, reflects the interest of the countries included in the Hub in making progress towards better connectivity standards in order to connect with the interior of the administrative units, with other industrial parks and with the ports with a view to exporting their products, either from the Caribbean coast of Venezuela or the Atlantic coasts of Guyana and Suriname and the Amazon ports in Brazil. In this regard, the associated projects seek to strengthen a connectivity network that is yet to reach international standards for freight transportation.

The **social** characterization of the Guianese Shield Hub is based on the Human Development Index (HDI), which is a summary measure of the human development achieved by a given society. The index measures the average progress attained in three basic dimensions: long and healthy life, access to education, and a decent standard of living. Overall, Venezuela, Brazil and Suriname belong, in relative terms, to the group of nations with a high HDI in the world context; however, the first two nations are quite apart from their partners in the Hub, since in absolute terms, they are in a better condition. Guyana is in the worst condition and among the nations having a medium HDI value.

The presence of indigenous communities is very significant in the territory of the Guianese Shield Hub, as they inhabit a great portion of its area. In general, rural communities are engaged in subsistence activities outside the region's formal economy, or as rural and mining salaried workers, and, in some cases, they engage in subsistence agriculture. Their way of life, which is

sustainable in all cases, is constantly threatened by invasion of lands for forest extraction or by large-scale mining operations, which leads to the degradation of large expanses of woody areas and rainforest, jeopardizing their economic, social and cultural survival.

At present, there are about 125 territorial units in the Hub with some degree of environmental protection, covering approximately an area of 950,000 km^2, a significantly vast territory as it accounts for about 60% of the total area of the Hub. A large part of this area is made up of vast natural reserves in southern Venezuela, equivalent to 470,000 km^2 of woody areas and wild rainforest. These ecosystems host the greatest biodiversity in the planet, not only in terms of species richness but also in terms of their unique environments.

In general terms, the territory of the Hub is mainly exposed to geodynamic hazards due to seismic movements, and to meteorological and hydrological hazards, produced by the heavy rainfall typical of the area. The Caribbean coastal strip is exposed to tsunamis caused by the eruption of submarine active volcanoes. Also generally speaking, the Caribbean coast is primarily affected by hydrometeorological hazards, such as large floods and landslides.

A global look at the infrastructure projected on the basis of the COSIPLAN-IIRSA Indicative Territorial Planning Methodology shows the challenge of contributing to the development of the entire Hub and, particularly, of some administrative units lagging behind, by adopting a sustainable approach, because although progress is observed in terms of the flow of goods and movement of people in all the territory of the Hub, greater attention needs to be paid to the administrative units that are still lagging behind.

Consequently, there is a need to implement and/or plan initiatives designed to create or strengthen the links among Brazil, Guyana, Suriname, and Venezuela. Furthermore, one of the most important challenges is to integrate the indigenous communities into these new prospects of improved connectivity, thus ensuring a sustainable development model on the basis of an inclusive society that not only respects diversity but also regards it as an asset for their subsistence.

1. INTRODUCTION

This document presents the socioeconomic and environmental characterization of the Guianese Shield Integration and Development Hub, which comprises a territory made up of administrative units (AUs) in Brazil, Guyana, Suriname and Venezuela.

This report forms part of the COSIPLAN-IIRSA Strategic Action Plan (PAE 2014-2015), which defines among its actions the updating of the social, economic, environmental and infrastructures data that characterize each one of the Hubs within the Project Portfolio identified by means of the Indicative Territorial Planning Methodology. This new report incorporates eight analytical components: Area of Influence, Demography, Infrastructure, Economy, Social Aspects, Environmental Aspects, Indigenous Communities, and Physical or Natural Hazards, thus providing a more comprehensive view of the Hub's characteristics, challenges and opportunities for integration.

The area of influence component defines the territory comprised within the Guianese Shield Hub and provides details concerning its administrative units, capital cities, main cities and border crossings, including reference maps.

As for demography, each country's population is provided on the basis of official sources, as well as the area and population density of each administrative unit in the Hub.

The chapter on infrastructure offers a general picture, with both figures and reference maps, of the road, rail, port, airport, and River transportation infrastructure as well as of the infrastructure related to energy generation.

Regarding the economic component that characterizes the Hub, up-to-date GDP figures are given, identifying, among other aspects, the relative contribution by country to the total GDP of the Hub. In addition, an analysis of the main economic activities in each country, in the administrative units and in the entire Hub is provided. This chapter also furnishes a map showing the territorial distribution of the GDP.

The report includes a description of the social component based on the human development index, while the environmental component is based on the presence of protected areas and indigenous communities. For each of these components there is a reference map indicating their distribution in the territory.

The hazard component combines an analysis of the hazards recognized as having a global impact -such as earthquakes, tsunamis and volcanoes-, of those having a regional impact -such as large floods-, and of the ones having a localized impact, such as landslides. For each type of hazard, the report provides a description in relation to the area of influence as well as a reference map.

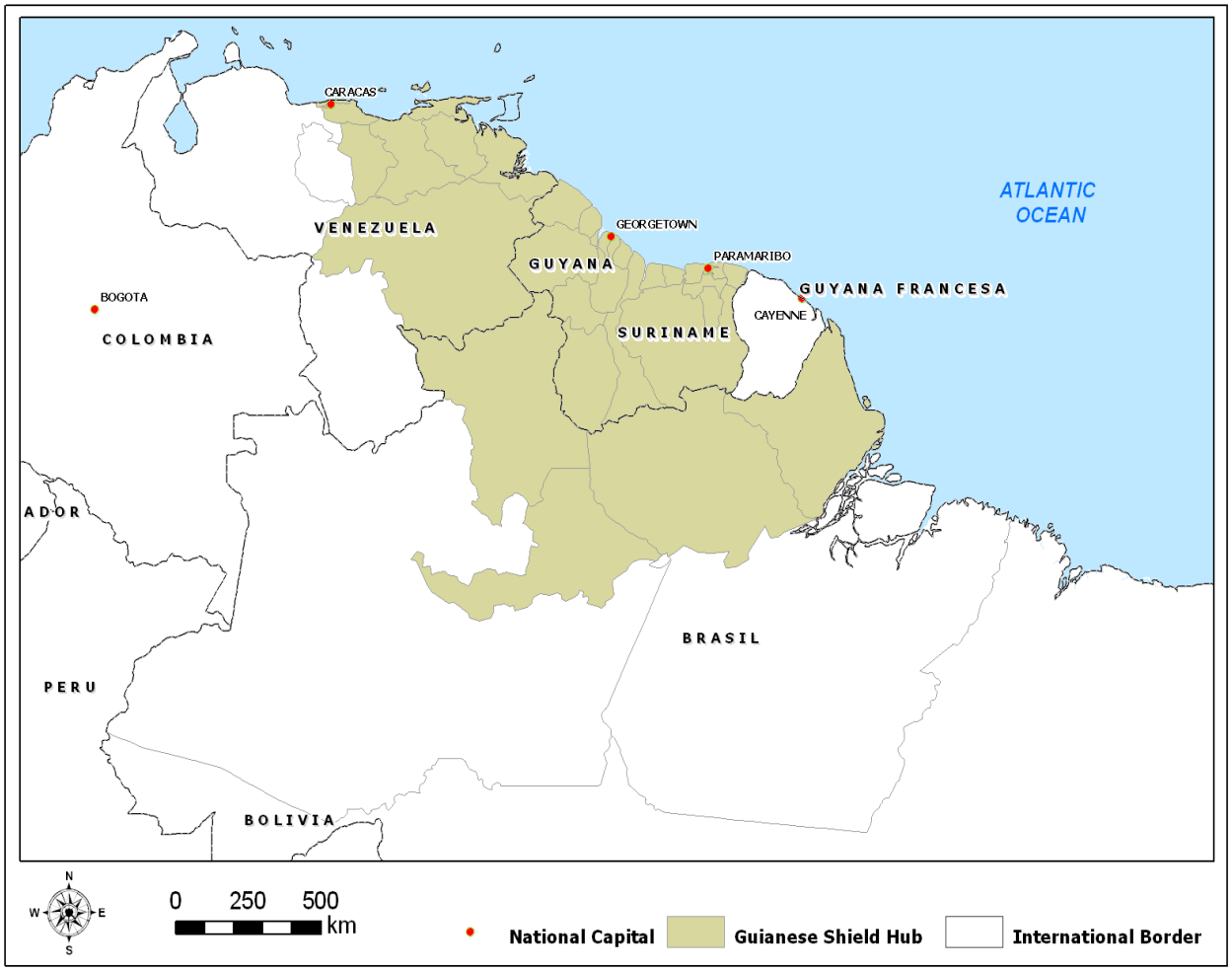
Finally, the document includes a chapter that summarizes and integrates the main characterization elements together with the limitations and opportunities encountered when the infrastructure planned and the components analyzed are confronted.

2. AREA OF INFLUENCE

The area of influence defined for the Guianese Shield Hub covers a territory of 1,603,643 km^2, accounting for 9% of the total area of the South American continent (**Figure 2.1**). This Hub is inhabited by 17,101,205 people, representing 4.2% of the total population of South America, thus being one of the least populated hubs in the continent. The details about the states, districts and regions[1] of Brazil, Guyana, Suriname and Venezuela that are included in this Hub are presented in **Table 2.1**.

The Guianese Shield Hub forms an area -**Figure 2.1**- covering the total territories of Guyana and Suriname; a significant portion of Venezuela comprising the states within the Orinoco basin, the Caribbean northern coast in addition to the capital district of Caracas; the whole territory of the Brazilian states of Roraima and Amapá, and a smaller area of the states of Amazonas and Pará, also in Brazil, including the municipality of Manaus, among others.

Figure 2.1: Area of Influence of the Guianese Shield Hub



Source: Prepared by the author

[1] Hereinafter, the states, regions and districts will be named Administrative Units, its acronym being AU

Table 2.1: Population and Area of the AUs within the Guianese Shield Hub

Country	Type of AU	Name	Population (# of inhabitants)	Area (km^2)	Density ($Inhab./km^2$)
Brazil (1) Total population: 204,450,649 (2014); Total area: 8,514,876,599 km^2	State	Amapá	766,679	142,828	5.4
		Amazonas[2]	2,012,773	155,058	2.5
		Pará[3]	313,219	265,476	1.2
		Roraima	505,665	224,303	2.3
		Subtotal	3,598,336	787,665	4.6
Guyana (2) Incorporates all its population and territory	Region	Barima-Waini	26,941	20,339	1.3
		Cuyuni-Mazaruni	20,280	47,213	0.4
		Demerara-Mahaica	313,429	2,232	140.4
		East Berbice-Corentyne	109,431	36,234	3.0
		Essequibo Islands-West Demerara	107,416	3,755	28.6
		Mahaica-Berbice	49,723	4,190	11.9
		Pomeroon-Supenaam	46,810	6,195	7.6
		Potaro-Siparuni	10,190	20,051	0.5
		Upper Demerara-Berbice	39,452	17,040	2.3
		Upper Takutu-Upper Essequibo	24,212	57,750	0.4
		Subtotal	747,884	214,999	3.5
Suriname (3) Incorporates all its population and territory	District	Brokopondo	14,215	7,364	1.9
		Commewijne	24,649	2,353	10.5
		Coronie	2,887	3,352	0.9
		Marowijne	16,642	4,627	3.6
		Nickerie	36,639	5,353	6.8
		Para	18,749	5,393	3.5
		Paramaribo	242,946	183	1,327.6
		Saramacca	15,980	3,636	4.4
		Sipaliwini	34,136	130,567	0.3
		Wanica	85,986	442	194.5
		Subtotal	492,829	163,270	3.0
Venezuela (4) Total population 30,620,401 (2015 pop. projected); total area 916,445km^2	State	Anzoátegui	1,658,398	43,300	38.3
		Bolívar	1,752,250	242,801	7.2
		Capital District	2,082,130	433	4.808.6
		Delta Amacuro	188,533	42,000	4.5
	F.Dependencies	Federal Dependencies	2,203	389	5.7
	State	Guárico	868,818	64,986	13.4
		Miranda	3,159,048	1,950	1.620.0
		Monagas	969,060	28,900	33.5
		Nueva Esparta	554,162	1,150	481.9
		Sucre	1,027,554	11,800	87.1
		Vargas	184,136	1,497	123.0
		Subtotal	12,262,156	437,709	28.0
Total			**17,101,205**	**1,603,643**	**6.7**

(1) Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics – IBGE). Population projection by sex and age groups, July 1st - 2000/2030. *http://www.ibge.gov.br/home/estatistica/populacao/projecao_da_populacao/2013/default_tab.shtm*

(2) Bureau of Statistics - Guyana. Guyana Population & Housing Census. Preliminary Report 2012. *http://www.statisticsguyana.gov.gy/census.html#census2012*

(3) Algemeen Bureau voor de Statistiek in Suriname. *http://www.statistics-suriname.org/*

http://www.citypopulation.de/Suriname-Cities.html

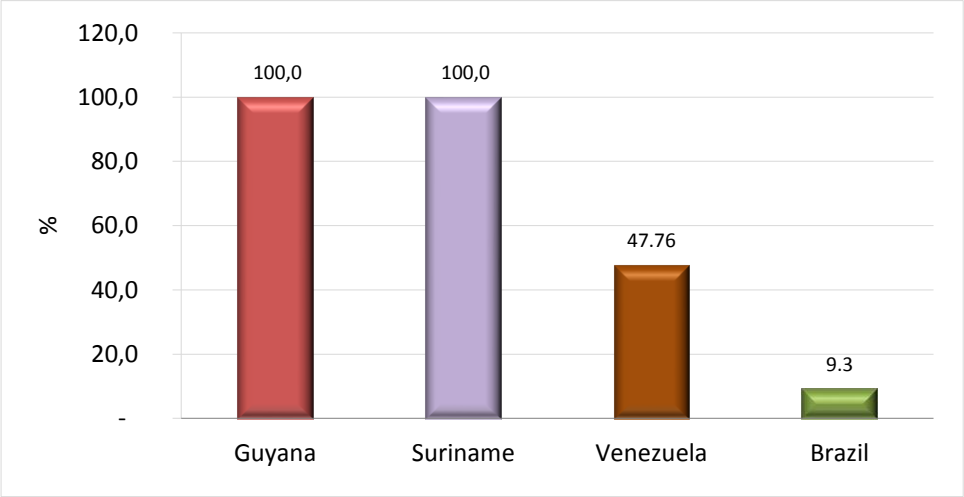
(4) Instituto Nacional de Estadísticas de Venezuela (National Institute of Statistics in Venezuela - INE) *http://www.ine.gov.ve/index.php?option=com_content&view=category&id=98&Itemid=51*

[2] The Amazonas state contributes approximately 9.9% of its area and the municipal towns of Anamã, Caapiranga, Careiro da Várzea, Codajás, Iranduba, Itacoatiara, Itapiranga, Manacapuru, Manaus, Nhamundá, Presidente Figueiredo, Rio Preto da Eva, São Sebastiao do Uatumã, Silves, and Urucará. See *http://www.ibge.gov.br/home/geociencias/areaterritorial/area.shtm*

[3] The Pará state contributes approximately 20.1% of its area and the municipal towns of Alenquer, Almeirim, Monte Alegre, Óbidos, and Oriximiná. See *http://www.ibge.gov.br/home/geociencias/areaterritorial/area.shtm*

The four countries together contribute 16.4% of their total areas to the Hub. If analyzed separately, Guyana and Suriname contribute 100% of their territory to the Hub, Brazil contributes only 9.3%, and Venezuela 47.76% (**Figure 2.1**).

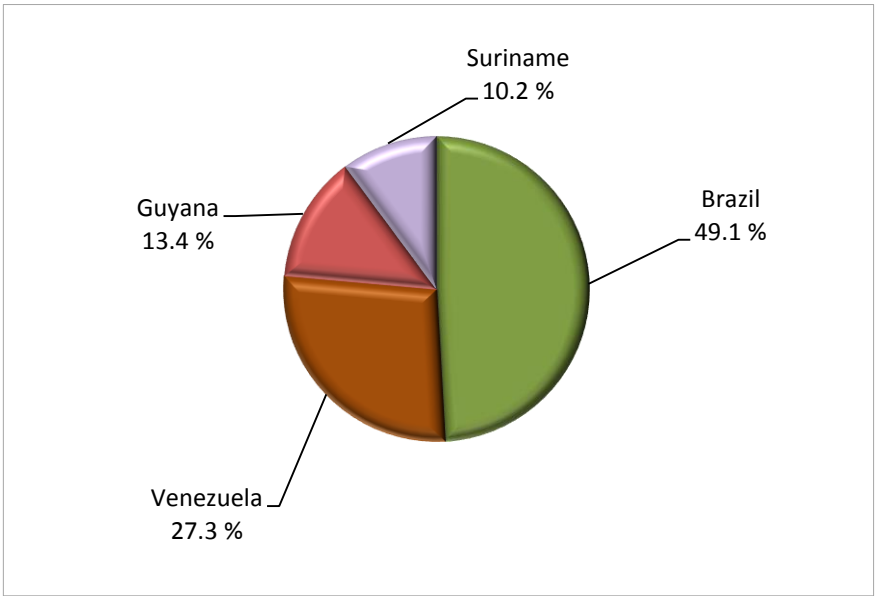
Figure 2.1: Contribution of Each Country's Territory to the Guianese Shield Hub vis-à-vis their Total Area



Source: Prepared by the author based on IBGE, BSG, INE and OSS data

When each country's relative contribution to the Hub's area is analyzed (**Figure 2.2**), the weight of Brazil stands out, because although it contributes small portions of two large states (Amazonas and Pará), in relative terms its contribution is significant, namely 49.1% of the Hub's total area. Venezuela ranks second, contributing 27.3%. Finally, in the case of Guyana and Suriname, despite the fact that their total territories are involved, their joint relative contribution accounts for only 23.6%.

Figure 2.2: Relative Contribution of each Country's Area to the Guianese Shield Hub



Source: Prepared by the author based on IBGE, BSG, INE and OSS data

The details of each country's administrative units included in the Hub, its main cities and border crossings in operation are presented below (**Tables 2.2** to **2.6** and **Figures 2.2** to **2.6**).

Table 2.2: Brazilian AUs in the Guianese Shield Hub

COUNTRY	Type of AU	AU	Capital	Main Cities/Municipalities Involved	BIZs / Border Crossings
Brazil	State	Amapá	Macapá	Santana	
		Amazonas	Manaos	Manaus, Manacapurú, Itacoatiará	
		Pará	Belém[(1)]	Monte Alegre, Oriximiná, Alenquer	
		Roraima	Boa Vista	Alto Alegre, Bonfin, Caracaraí, Rorainópolis	Paracaíma, Bonfin

Source: Prepared by the author

[(1)] The capital city of the Pará state and the municipality of Belém are not comprised within the Guianese Shield Hub. They are mentioned for reference only.

Figure 2.2: Area of Influence of the Guianese Shield Hub in the Brazilian Territory

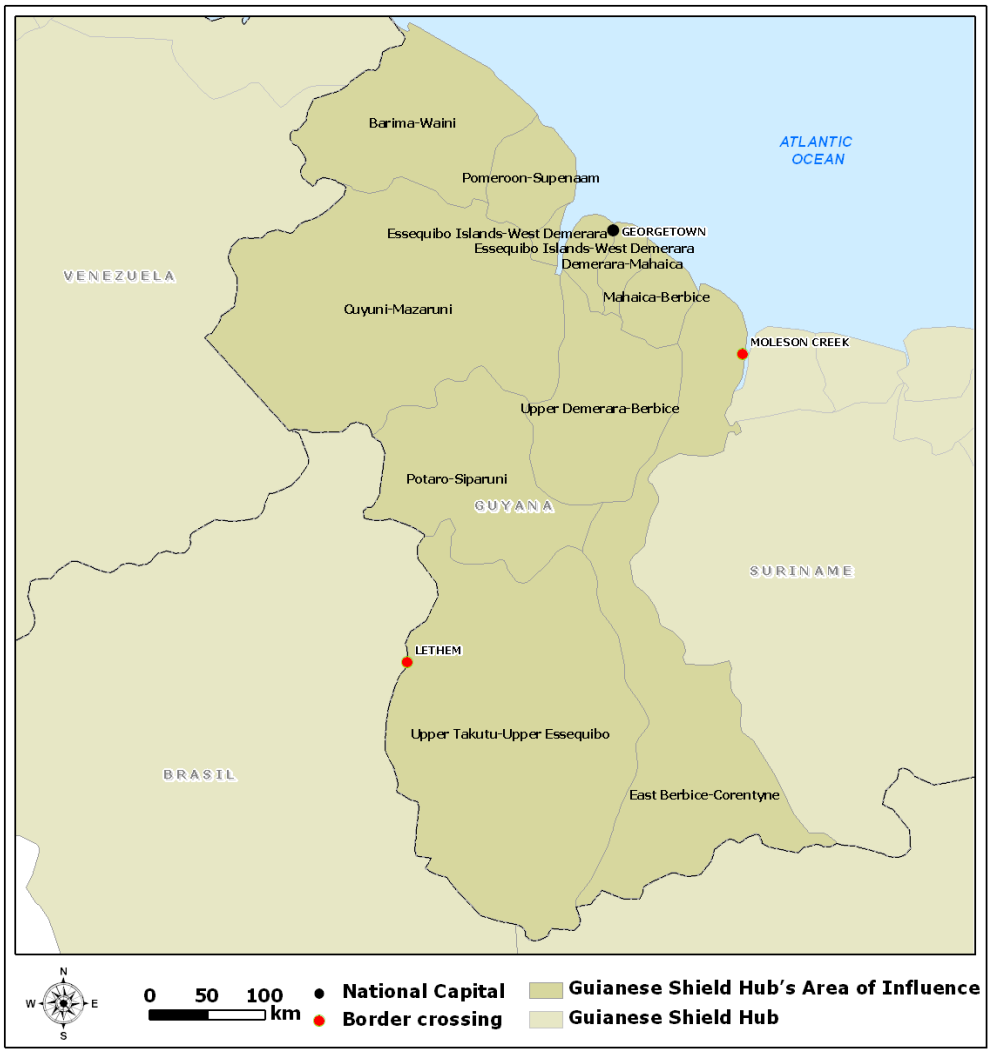
Source: Prepared by the author

Table 2.3: Guianese AUs within the Guianese Shield Hub

COUNTRY	Type of AU	AU	Capital	Main Cities	BIZs / Border Crossings
Guyana	Region	Barima-Waini	Mabaruma		
		Cuyuni-Mazaruni	Bartica		
		Demerara-Mahaica	Georgetown	Mahaica	
		East Berbice-Corentyne	New Amsterdam	Skeldon	Moleson Creek
		Essequibo Islands-West Demerara	Vreed-en-Hoop	Parika	
		Mahaica-Berbice	Fort Wellington	Rosignol	
		Pomeroon-Supenaam	Anna Regina		
		Potaro-Siparuni	Mahdia		
		Upper Demerara-Berbice	Linden		
		Upper Takatu-Upper Essequibo	Lethem		Lethem

Source: Prepared by the author

Figure 2.3: Area of Influence of the Guianese Shield Hub in the Guyanese Territory



Source: Prepared by the author

Table 2.4: Surinamese AUs within the Guianese Shield Hub

COUNTRY	Type of AU	AU	Capital	Main Cities	BIZs / Border Crossings
Suriname	District	Brokopondo	Brokopondo	Brownsweg	
		Commewijne	Nieuw-Amsterdam	Marienburg	
		Coronie	Totness		
		Marowijne	Albina	Moengo	
		Nickerie	Nieuw-Nickerie	Wageningen	South Drain
		Para	Onverwacht		
		Paramaribo	Paramaribo		
		Saramacca	Groningen		
		Sipaliwini	None		
		Wanica	Lelydorp		

Source: Prepared by the author

Figure 2.4: Area of Influence of the Guianese Shield Hub in the Surinamese Territory

Source: Prepared by the author

Table 2.5: Venezuelan AUs within the Guianese Shield Hub

COUNTRY	Type of AU	AU	Capital	Main Cities	BIZs / Border Crossings
Venezuela	State	Anzoátegui	Barcelona	Puerto La Cruz	
		Bolívar	Cuidad Bolívar	Ciudad Guayana	BIZ / Santa Elena de Uairén
		Delta Amacuro	Tucupita		
		Guárico	San Juan de los Morros		
		Miranda	Los Teques	Petare, Santa Teresa del Tuy	
		Monagas	Maturín		
		Nueva Esparta	La Asunción		
		Sucre	Cumaná		
		F. Dependencies	Federal Dependencies		
		Vargas	La Guaira		
		Capital District	Caracas		

Source: Prepared by the author

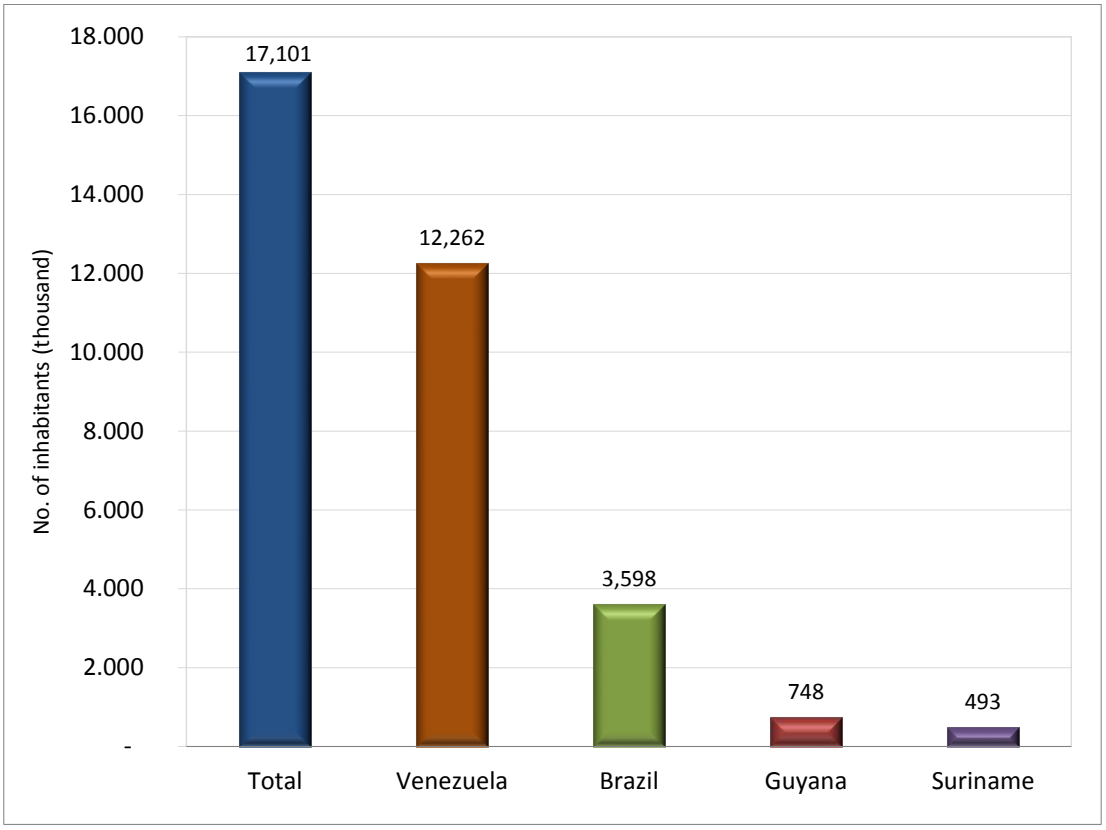
Figure 2.5: Area of Influence of the Guianese Shield Hub in the Venezuelan Territory

Source: Prepared by the author

3. DEMOGRAPHY

The Guianese Shield Hub has a total population of 17,101,205 inhabitants, accounting for 4.2% of the South American population. In nominal terms, Venezuela, through the administrative units included in the Hub, contributes more than 17 million inhabitants, followed by Brazil with more than 3,5 million and, far behind, by the other countries of the Hub (**Figure 3.1**). Detailed information on the population in each of the countries and their respective administrative units is presented in **Table 2.1** above.

Figure 3.1: Population Living in the Guianese Shield Hub by Country

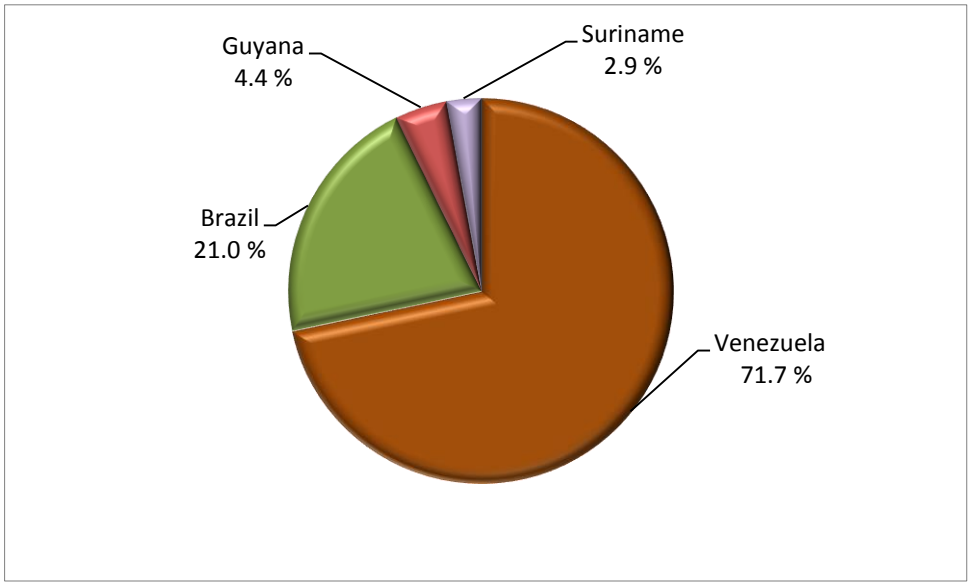


Source: Prepared by the author based on the information supplied by the institutions concerned with statistics in each country

If each country's relative contribution to the Hub's total population is analyzed, Venezuela ranks first, well above the other countries, as its relative contribution accounts for 71.7% of the total population of the Hub, followed by Brazil with 21%. Guyana and Suriname, jointly considered, contribute only 7.3% to the Hub's total population (**Figure 3.2**).

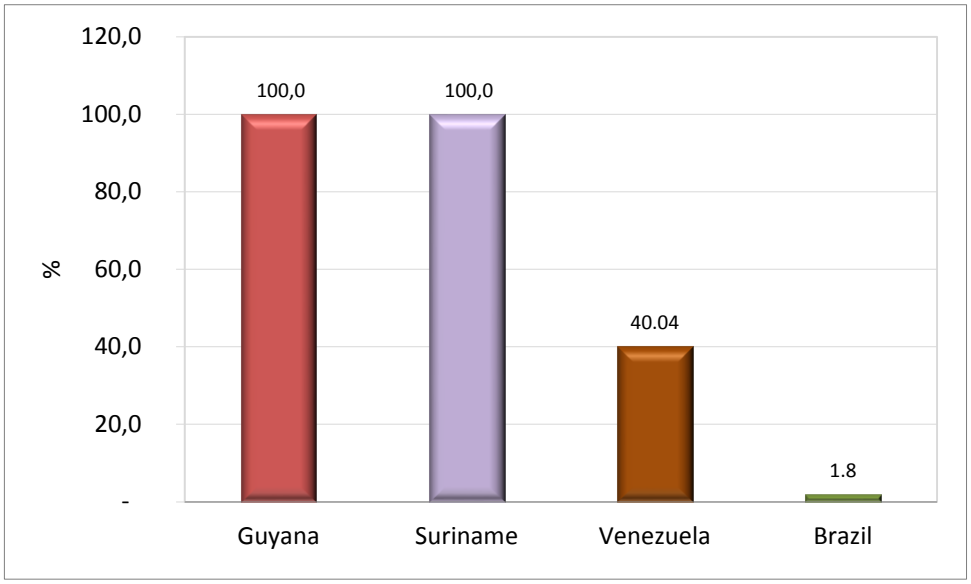
When the contribution of each country is measured in relation to its own total population (**Figure 3.3**), the picture changes substantially: Guyana and Suriname contribute 100% of their inhabitants, followed by Venezuela with 40% of its population and Brazil, having only 1.8% of its population comprised within the Hub, given the fact that only a small part of its territory and of the municipal towns in the states of Amazonas and Pará are included.

Figure 3.2: Relative Contribution by Country to the Guianese Shield Hub's Total Population (53,509,280 inhabitants)



Source: Prepared by the author based on the information supplied by the institutions concerned with statistics in each country

Figure 3.3: Total Population of Each Country Involved in the Guianese Shield Hub (%)

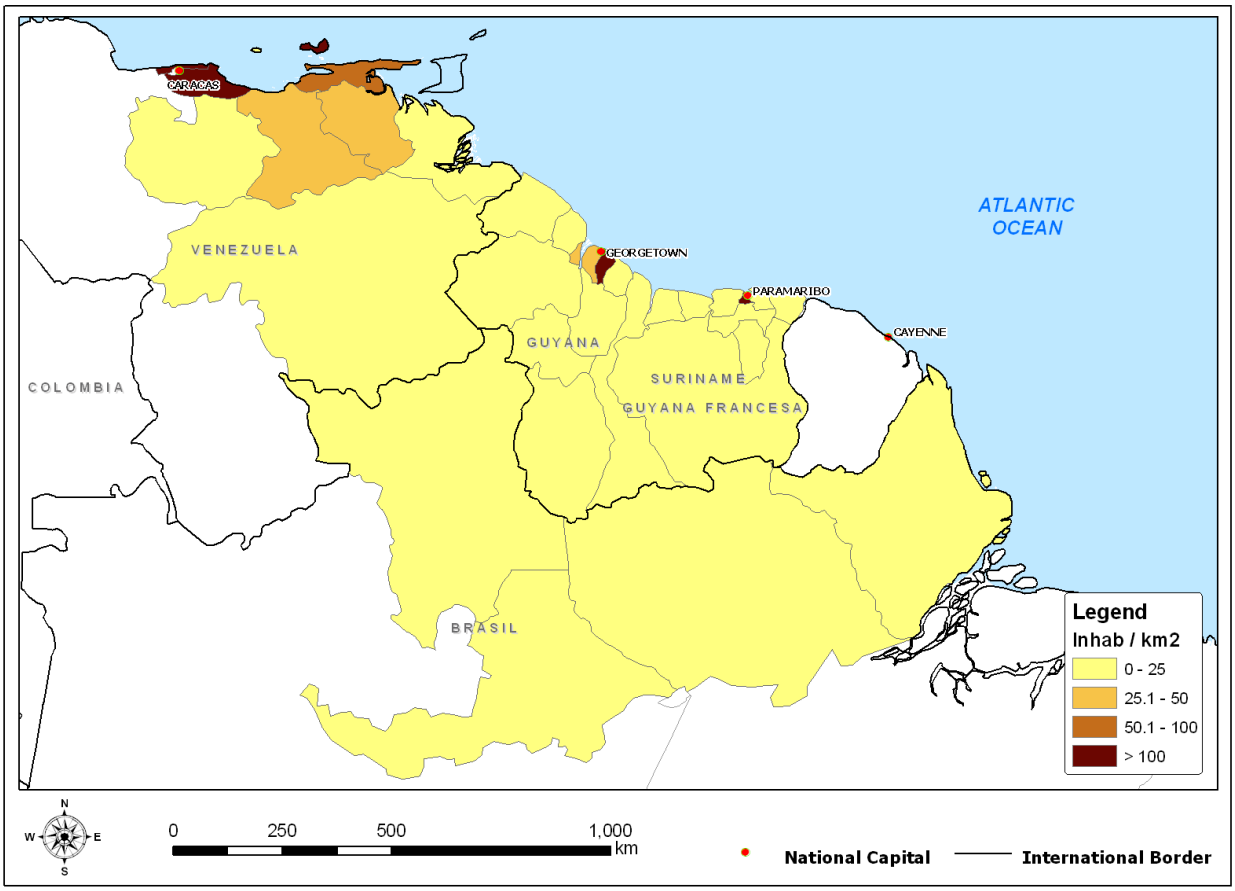


Source: Prepared by the author based on the information supplied by the institutions concerned with statistics in each country

Regarding the population density of its territory (inhab./km^2), the Guianese Shield Hub features a low population rate overall, its average being 10,7 inhab./km^2, well below other Hubs' population density, such as the MERCOSUR-Chile and the Andean Hubs, with an average of 44 and 40 inhab./km^2, respectively. However, the administrative units that are more densely

populated are the states of Miranda and the Capital District (Caracas) in Venezuela, the population density of which is 1,620 and 4,606 inhab./km^2, respectively, as well as the district of Paramaribo, Suriname's capital city, with a population density of 1,327.6 inhab./km^2 (**Table 2.1**). The other administrative units have a low to very low population density, so that the Hub covers a vast, though scarcely populated, territory. Its population is higher in the Venezuelan administrative units and the capitals of Suriname and Guyana (**Figure 3.1**).

Figure 3.1: Population Density in the Guianese Shield Hub



Source: Prepared by the author based on the information supplied by the institutions concerned with statistics in each country

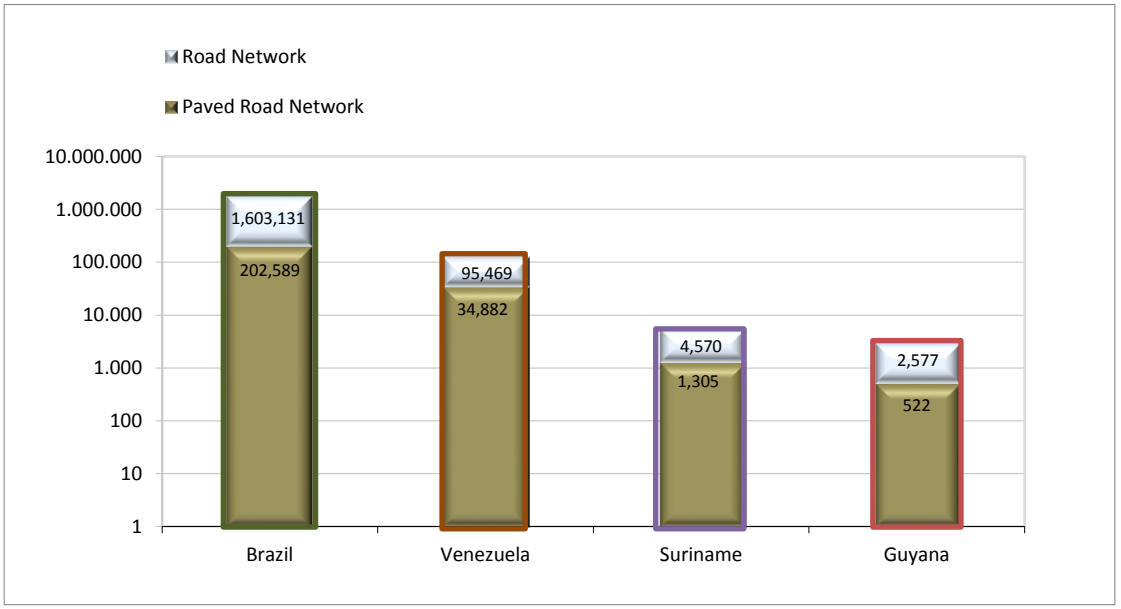
4. INFRASTRUCTURE

4.1 Road Network

The road network of the countries involved in the Guianese Shield Hub covers a total length of 1,705,547 km, of which only 24.5% are paved, i.e. 239,298 km.

If each country is analyzed separately and in nominal values (**Figure 4.1**), Brazil is the one with the longest road network, totaling more than 1,600,000 km, followed by Venezuela with 95,469 km, Suriname with 4,570 km, and Guyana with 2,577 km.

Figure 4.1: Length of the Road Network in the Countries Involved in the Guianese Shield Hub (km – logarithmic scale)



Source: Prepared by the author on the basis of ECLAC's and national sources' data

If only paved roads are considered, the analysis by country yields a relatively low percentage for Brazil, with 12% of its total road network being paved, which can be accounted for by the great length of its network. At the opposite end is Venezuela, which has 36.5% of its roads already paved, followed by Suriname with 28.6%, and by Guyana, which has 20.3% of its road network paved (**Figure 4.1**).

In the area of the Guianese Shield Hub, there are some relevant road connections that link urban centers, agricultural production areas (mainly devoted to sugarcane and rice), forestry areas and mining centers in the interior of the Hub with ports for export operations on the Caribbean coast of Venezuela as well as with Atlantic ports in Guyana and Suriname. Among the most important ones, the following can be mentioned:

Caracas (VE) – Boa Vista (BR) – Georgetown (GU) Corridor

It runs from Caracas through Barcelona to Ciudad Guayana, and then passes through the border crossing of Santa Elena de Uairén into Brazil. From there onwards, the corridor connects with

Guyana through the Pacaraima-Boa Vista-Turn-off to Bonfim paved section, passing through the Takutu international bridge up to the city of Lethem. At this point, the Rupununi road, spanning approximately 450 km and unpaved, gets up to the pontoon boat crossing over the Esequibo River, and arrives in the city of Linden. The last Linden-Georgetown road section has already been paved, meeting international transportation standards.

Caracas (VE) – Boa Vista (BR) – Manaus (BR) Corridor

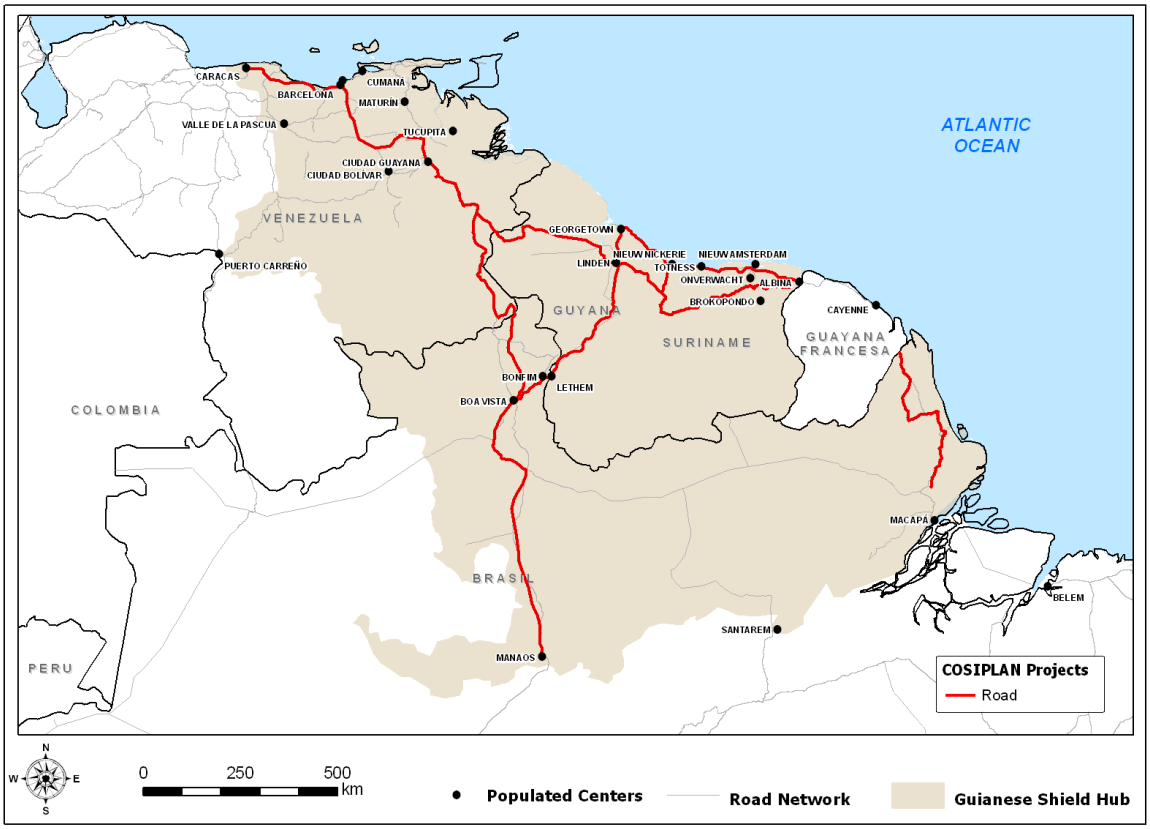
It runs from Caracas through Barcelona to Ciudad Guayana, and then heads past the border crossing of Santa Elena de Uairén into Brazil. Here, the corridor runs through the Pacaraima-Boa Vista-Manaus road section, which is paved.

Georgetown (GU) – Paramaribo (SU) – Cayenne (FG) Corridor

It runs from Georgetown to CorRiverton along a paved highway and, through the boat crossing over the Corentyne River, gets to Niew Nickerie, Suriname. At this point, the corridor runs through paved roads to Paramaribo, and then to the city of Albina, close to the border with French Guiana, in which it arrives after the Maroni River is crossed over by boat.

Of the road corridors planned for the future, the road connection linking Venezuela, Guyana, Suriname, French Guiana, and Brazil can be mentioned. This project involves the construction of a paved road between San Martín de Etherinbang, in the Venezuelan state of Bolívar, and the city of Linden, in Guyana, which is in turn connected to the city of Georgetown, Guyana, through a paved road, and with the Paramaribo-Cayenne-state of Amapá corridor.

Figure 4.1: Road Network and COSIPLAN-IIRSA Indicative Territorial Planning in the Guianese Shield Hub

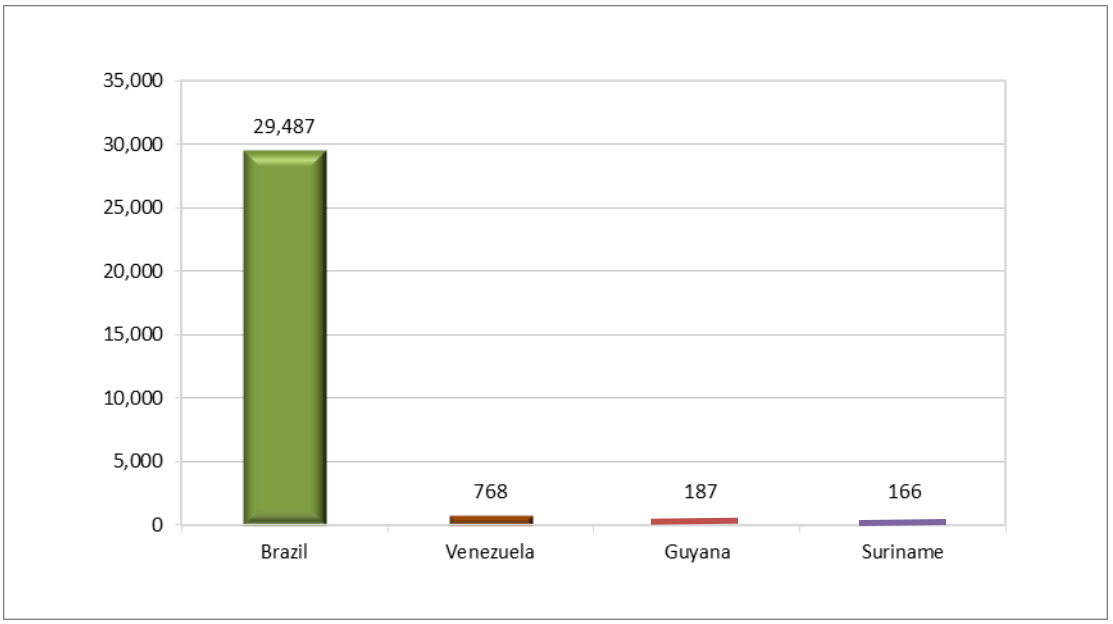


Source: Prepared by the author

4.2 Rail Network

The rail network in the countries involved in the Guianese Shield Hub covers 30,608 km. If the countries are analyzed separately in nominal values, Brazil stands out with its, approximately, 29,500 km (**Figure 4.2**), accounting for 96.3% of the total rail network of the Hubs. The other 3.7% is shared by Venezuela, which features 768 km, accounting for 2.5%, and by Guyana and Suriname, both of them with a similar percentage, close to 0.6%, equivalent to about 170 km of rail lines each.

Figure 4.2: Length of the Rail Network in the Countries Included in the Guianese Shield Hub (km)



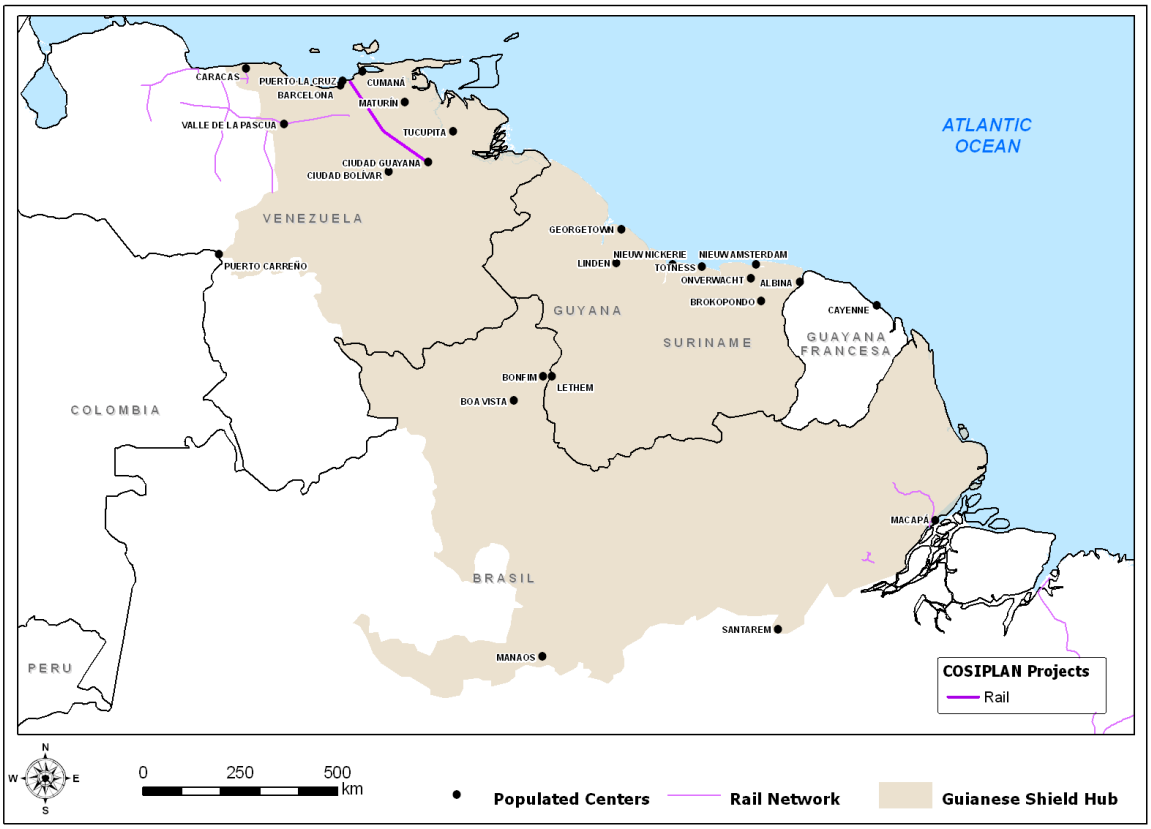
Source: Prepared by the author

In the territory of the Guianese Shield Hub, the rail connections are poorly developed, and of the total network (running about 350 km if the total rail network of Guyana and Suriname is considered), only a few sections are operational.

From the information gathered, it can be stated that in Guyana there is an active cargo railway running along 51.5 km along the mining area of Matthews Ridge in the Barima-Waini region.

In the case of Venezuela, there are rail construction projects intended to link all the regions of the country. The following projects in the territory of Venezuela comprised within the Hub can be mentioned: Ciudad Guayana-Puerto La Cruz, Ciudad Bolívar-Abejales, Guanta-Ciudad Guayana, Ciudad Guayana-Santa Elena del Uairén, and Barcelona-Puerto Ayacucho.

Figure 4.2: Rail Network and COSIPLAN-IIRSA Indicative Territorial Planning in the Guianese Shield Hub



Source: Prepared by the author

4.3 Port System

The sea and river port system in the Guianese Shield Hub is made up of at least 28 major ports (**Figure 4.1**), located essentially on the Caribbean coasts of Venezuela and by the Atlantic Ocean and the Amazon River (**Figure 4.3**).

In the Venezuelan Caribbean region, the Caripito and Puerto La Cruz oil terminals and La Guaira port (the most important one in the country), together with Guanta and Carúpano ports, stand out.

The Amazon River ports are mainly for bulk operations, particularly solid bulk, fuel and mineral cargo. Additionally, the Amazon River plays a significant role in passenger and small cargo transportation, as it is the main route for communication in the region.

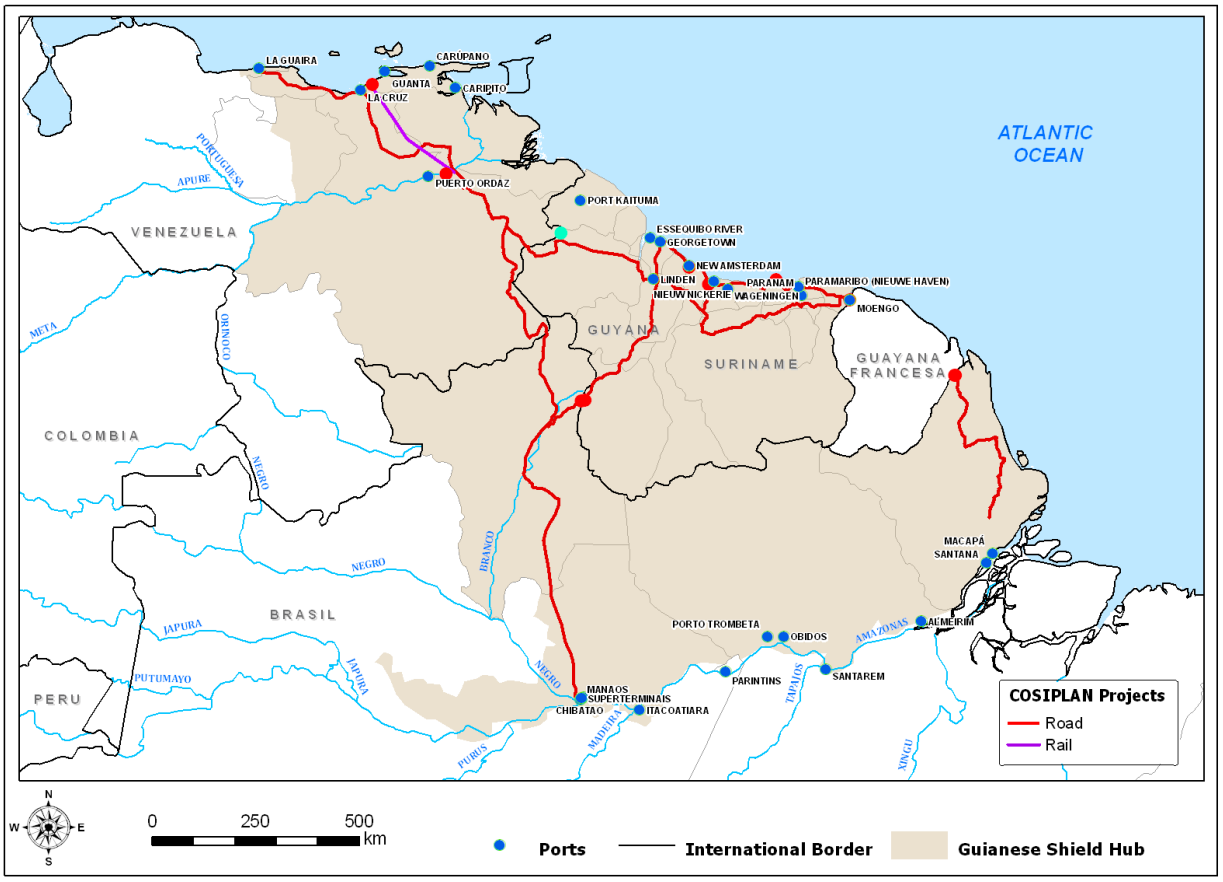
In Guyana and Suriname, the Atlantic ports handle more than 97% of the goods imported into or exported from the countries, mainly minerals (particularly, bauxite) and agribulks, although their facilities can also handle container traffic. A list of the major ports in the region and of the main goods handled by them is presented below.

Table 4.1: Major Sea and River Ports in the Guianese Shield Hub

COUNTRY	Port	Departure Route	Main Products
Brazil	Almeirim	Amazon / Atlantic Ocean	Liquid bulk, containers
	Chibatão	Amazon / Atlantic Ocean	Containers, general cargo
	Itacoatiara	Amazon / Atlantic Ocean	Solid bulk, agribulks, fuels
	Macapá	Atlantic Ocean	General cargo, manganese ore, fuels
	Manaus	Amazon / Atlantic Ocean	Solid bulk, containers, fuels
	Óbidos	Amazon / Atlantic Ocean	River transportation
	Parintins	Amazon / Atlantic Ocean	River transportation
	Porto Trombetas	Amazon / Atlantic Ocean	Solid bulk
	Prainha	Amazon / Atlantic Ocean	River transportation
	Santarém	Amazon / Atlantic Ocean	Containers, agribulks
	Santana	Atlantic Ocean	Iron ore, forestry
	Super Terminais	Amazon / Atlantic Ocean	Containers, general cargo
Guyana	Essequibo River	Essequibo River, Atlantic Ocean	N/D
	Georgetown	Atlantic Ocean	Bauxite, sugar, containers, general cargo
	Kaituma	Kaituma River, Atlantic Ocean	N/D
	Linden	Demerara River/ Atlantic Ocean	N/D
	New Amsterdam	Atlantic Ocean	N/D
Suriname	Moengo	Atlantic Ocean	Containers, liquid bulks, fuels
	Nieuw Nickerie	Nickerie River, Atlantic Ocean	Rice, containers
	Paramaribo (Nieuwe Haven)	Suriname River, Atlantic Ocean	Liquid bulk, containers, general cargo
	Paranam	Atlantic Ocean	Bauxite, aluminum oxide
	Wageningen	Atlantic Ocean	N/D
Venezuela	Caripito	Caripito River, Atlantic Ocean	Hydrocarbons
	Carúpano	Atlantic Ocean	General cargo
	Guanta	Atlantic Ocean	Bulk cargo, containers, coal, project cargoes, agribulks, hydrocarbons, petrochemical products
	La Cruz	Atlantic Ocean	Oil
	La Guaira	Atlantic Ocean	Containers, vehicles, general cargo, solid and liquid bulk
	Puerto Ordaz	Orinoco River	Minerals, bauxite, iron

Source: Prepared by the author

Figure 4.3: Port Infrastructure and COSIPLAN-IIRSA Indicative Territorial Planning in the Guianese Shield Hub



Source: Prepared by the author

Regarding the cargo volumes handled by the major ports in the Hub (more than 10,000,000 MT), the Brazilian Trombetas port on the Amazon River stands out, since in 2013 it handled more than 17,000,000 MT. The volume of the cargo handled in the regional ports that are among the 100 most important ports in South America and the Caribbean is presented below (**Table 4.2**).

Table 4.2: Movement of Bulk Cargo in the Major Sea Ports in the Guianese Shield Hub (MT)

Port	Country	2011 (TON)	2012 (TON)	2013 (TON)
Porto Trombetas	Brazil	17,893,462	16,391,516	17,482,163
Manaus	Brazil	5,939,656	6,593,923	5,297,018
La Guaira	Venezuela	2,513,400	3,062,973	2,914,754

Source: Prepared by the author on the basis of ECLAC, 2014

As for container traffic, the most important port is La Guaira, in Venezuela, which handled more than 500,000 TEUs[4] in 2013. A very similar volume is observed at the Brazilian port of Chibatão,

[4] TEU: Twenty-foot Equivalent Unit. Cargo capacity of a standard-size, 20-foot container

having handled more than 460,000 TEUs in 2014, followed far behind by the Nieuwe Haven port in Suriname, with 192,728 TEUs that same year (**Table 4.3**).

The volume of the containerized cargo traffic (measured in TEUs) in the ports of the Hub that are among the 100 most important ports in South America and the Caribbean is listed below.

Table 4.3: Container Traffic in the Major Sea Ports of the Guianese Shield Hub (TEUs)

Port	Country	2012 (TEUs)	2013 (TEUs)	2014 (TEUs)
Chibatão	Brazil	273,559	362,710	463,423
Super Terminais	Brazil	187,423	196,342	176,074
Santarém	Brazil	4,218	3,150	733
Nieuwe Haven	Suriname	103,961	108,020	192,728
La Guaira	Venezuela	542,710	502,418	N/D
Guanta	Venezuela	70,794	65,355	N/D

Source: Prepared by the author on the basis of ECLAC, 2014

4.4 Airport System

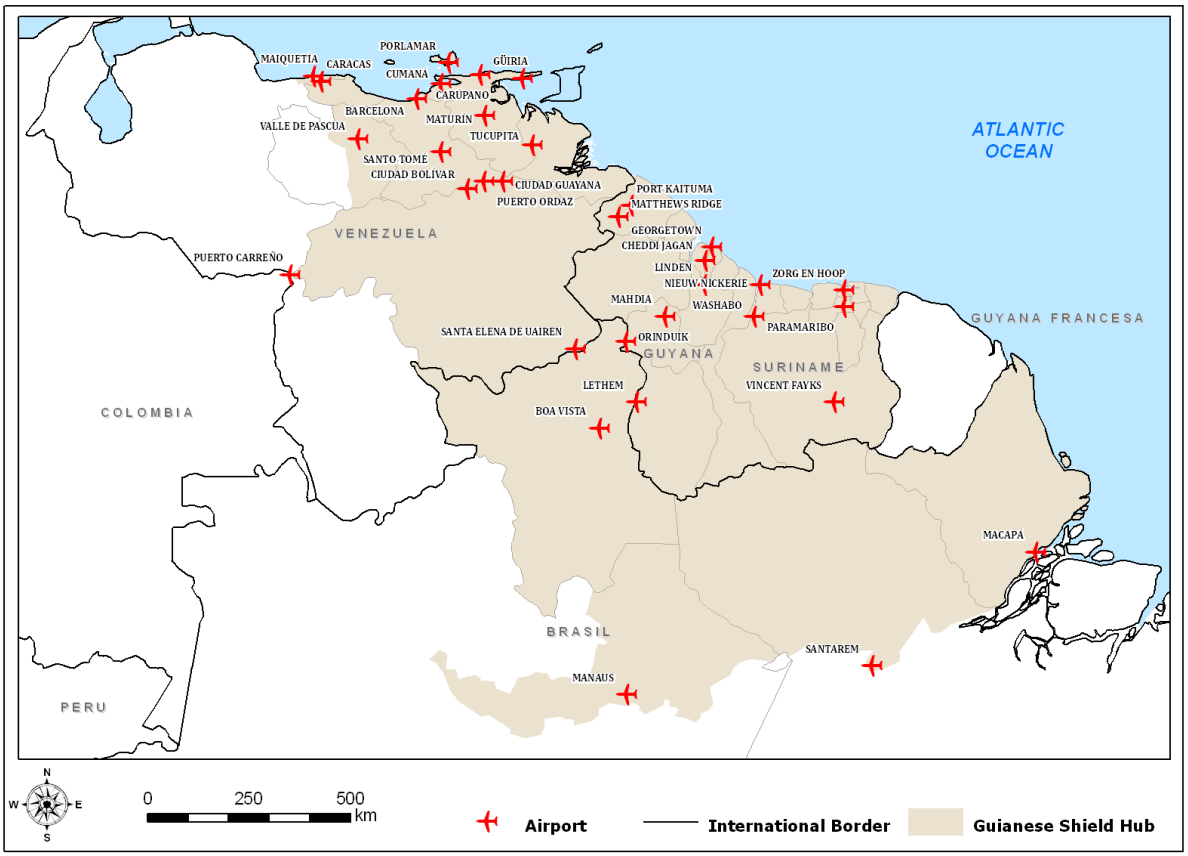
The airport system in the Guianese Shield Hub is made up of at least 32 major airports, 17 of which are international. Cargo transportation is very limited and is mainly concerned with imports of industrial manufactures from countries other than those involved in the Hub to Manaus (BR), Georgetown (GU), and Paramaribo (SU). A list of the major airports in the Guianese Shield Hub, including their categories, is presented below (**Table 4.4**). Their geographical distribution is shown in **Figure 4.4**.

Table 4.4: Major Airports in the Guianese Shield Hub

COUNTRY	Airport	Type	COUNTRY	Airport	Type
Brazil	Boa Vista	International	Venezuela	Güiria	Domestic
	Bonfim	Domestic		Carúpano	Domestic
	Santarem	Cabotaje		Santo Tomé	Domestic
	Manaos	International		Puerto Carreño	Domestic
	Macapá	International	Guyana	Cheddi Jagan / Georgetown	International
Venezuela	Maiquetía	International		Linden	Domestic
	Barcelona	International		Lethem	Domestic
	Porlamar	International		Port Kaituma	Domestic
	Maturín	International		Matthews Ridge	Domestic
	Ciudad Guayana	International		Orinduik	Domestic
	Cumaná	International		Mahdia	Domestic
	Santa Elena de Uairen	Domestic	Suriname	Washabo	Domestic
	Ciudad Bolívar	Domestic		Nieuw Nickerie	Domestic
	Valle de Pascua	Domestic		Zorg en Hoop	Domestic
	Caracas	Domestic		Paramaribo	International
	Tucupita	Domestic		Vincent Fayks	Domestic

Source: Prepared by the author

Figure 4.4: Airport Infrastructure in the Guianese Shield Hub



Source: Prepared by the author

4.5 River Transportation

River transportation in the region is carried out mainly along the Amazon and Orinoco Rivers and, to a lesser extent, along the Essequibo, Demerara, and Berbice Rivers in Guyana and the Corentyne, Marowijne, Suriname, Nickerie, and Coppename Rivers in Suriname.

Amazon River: This is the main River in the Hub, hosting the most important ports in the Brazilian northern region. It also receives the traffic of ships coming from inland waterways towards the Atlantic, such as the Madeira, Tapajós and Tocantins Rivers. Its depth enables 60,000-DWT[5] ships to travel up to the city of Manaus, where there is a great number of private ports. The main goods transported include solid and liquid bulk cargoes, fuels and containerized merchandise. Passenger transportation is very significant: it is operated by 76 companies with 88 ships carrying about 550,000 people and 320,000 tons per year. The main passenger ports are Manaus, Óbidos, Santarém, and Itacoatiara.

Orinoco River: Even though ships travel all along its course, including its tributaries Apuré and Portuguesa, most of this river traffic goes up to Puerto Ordaz (Ciudad Guayana), a city located

[5] DWT: Deadweight tonnage. It refers to the tons of cargo that a vessel can actually carry. It does not include the weight of the ship with an empty hold

in the Caroni River mouth. From San Félix to Matanzas, there are more than a dozen private ports with different levels of infrastructure, most of them devoted to meeting the needs of companies producing primary aluminum, aluminum oxide, and anodes for the aluminum and iron and steel industries. The main products transported are petroleum coke, tar, bauxite, aluminum oxide, iron and steel products, bulk hydrocarbons, and inputs for the petrochemical and iron and steel industries.

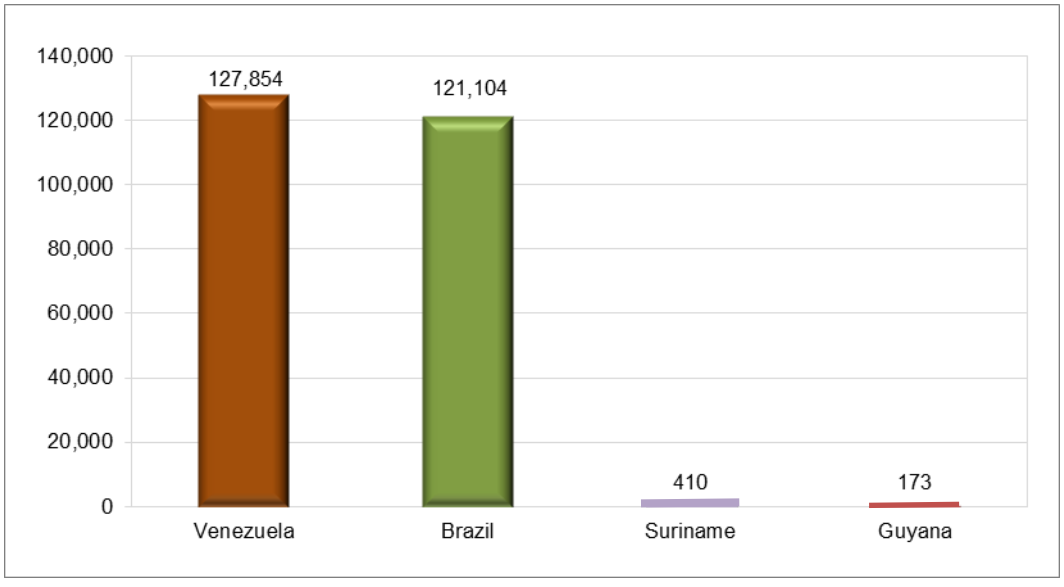
Berbice, Demerara, and Essequibo Rivers: These are the main rivers for transportation in Guyana. Although transport to the Georgetown port is usually carried out in barges (carrying sugar, rice, bauxite, and minerals), 55,000-DWT Ocean ships also travel up to 150 km upstream the Berbice River mouth. Very large vessels can also travel about 100 km upstream along the waterways of the Demerara and Essequibo Rivers.

Corentyne, Marowijne, Suriname, Nickerie, and Coppename Rivers: These are the most important rivers for transportation in Suriname. Most of the traffic takes place at the Paramaribo port, located by the Suriname River about 15 km away from where it flows into the Atlantic Ocean. This is followed in importance by the Corentyne River and the main port on it, Nieuw Nickerie, where commodities (particularly rice) from the interior of the country are loaded on board vessels.

4.6 Energy

Concerning electricity generation, in 2013 all the countries involved in the Hub had an installed capacity of about 250,000 MW. If the countries are analyzed separately in terms of nominal values, Brazil and Venezuela have an installed capacity greater than 120,000 MW. Instead, Guyana and Suriname have much smaller values, since the installed capacity in both countries considered together was less than 600 MW in 2013 (**Figure 4.5**).

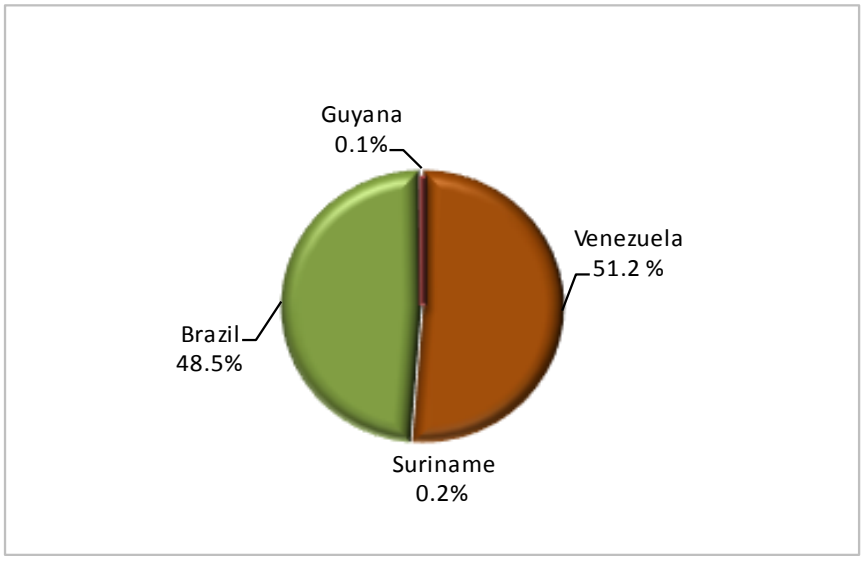
Figure 4.5: Electricity Generation – Installed Capacity (MW)
2013 Data



Source: Prepared by the author based on CIER (Regional Energy Integration Commission), 2014

If the contribution to the Hub's installed capacity for electricity generation is analyzed in terms of each country (**Figure 4.6**), the role played by Brazil and Venezuela is almost the same, accounting for 99.7%, whereas the contribution made by Guyana and Suriname is irrelevant, accounting for 0.3%.

Figure 4.6: Relative Contribution by Country to the Installed Capacity for Electricity Generation in the Guianese Shield Hub (%)



Source: Prepared by the author based on CIER (Regional Energy Integration Commission), 2014

5. ECONOMY

The GDP of the administrative units in the area of influence of the Guianese Shield Hub amounts to US$ 338,963 million at 2014 current prices (**Table 5.1**), representing 7.4% of the South American GDP for the same year, which makes the Hub rank seventh among the nine Hubs included in the COSIPLAN-IIRSA Indicative Territorial Planning.

Table 5.1: GDP by Country and AU, Guianese Shield Hub

COUNTRY	Type of AU	NAME	Administrative Unit' GDP as of 2014 (Million US$)	Country' GDP at 2014 current prices based on ECLAC (Mill. US$) (5)	Country's GDP per capita at 2014 current prices based on ECLAC (US$) (6)
Brazil (1)	State	Amapá	4,692	2,345,894	11,642
		Amazonas	37,534		
		Pará	49,264		
		Roraima	4,692		
		Subtotal	96,182		
Guyana (2)	Region	Barima-Waini	111	3,086	3,840
		Cuyuni-Mazaruni	84		
		Demerara-Mahaica	1,293		
		East Berbice-Corentyne	452		
		Essequibo Ids-West Demerara	443		
		Mahaica-Berbice	205		
		Pomeroon-Supenaam	193		
		Potaro-Siparuni	42		
		Upper Demerara-Berbice	163		
		Upper Takutu-Upper Essequibo	100		
		Subtotal	3,086		
Suriname (3)	District	Brokopondo	164	5,681	10,444
		Commewijne	284		
		Marowijne	192		
		Nickerie	422		
		Para	216		
		Paramaribo	2,801		
		Saramacca	184		
		Sipaliwini	393		
		Wanica	991		
		Subtotal	5,681		
Venezuela (4)	State	Anzoátegui	31,808	567,997	18,423
		Bolívar	31,240		
		Capital District	47,144		
		Delta Amacuro	2,840		
	F. Dependencies	Federal Dependencies	-		
	State	Guárico	15,904		
		Miranda	49,416		
		Monagas	18,744		
		Nueva Esparta	12,496		
		Sucre	19,312		
		Vargas	5,112		
		Subtotal	234,015		
Total			**338,963**	**2,922,658**	

(1) Brazil: Participação das Grandes Regiões e Unidades da Federação no valor adicionado bruto a preços básicos, por atividade ecônomica - 2002-2011. *http://www.ibge.gov.br/home/estatistica/economia/contasregionais/2011/default_xls_2002_2011.shtm*

(2) Bureau of Statistics - Guyana. Guyana Population & Housing Census. Preliminary Report 2012 *http://www.statisticsguyana.gov.gy/census.html#census2012* This was used as proxy to distribute the national GDP and the % of population among the respective regions, consistent with the business markets and the population density by district

(3) http://www.statistics-suriname.org/ - *http://www.citypopulation.de/Suriname-Cities.html* This was used as proxy to distribute the national GDP and the % of population among the respective districts

(4) Instituto Nacional de Estadísticas de Venezuela (National Institute of Statistics of Venezuela – INE) *http://www.ine.gov.ve/documentos/Economia/IVCensoEconomico/pdf/InformeIVCE.pdf*

(5) ECLAC, 2015, at *http://interwp.cepal.org/cepalstat/WEB_CEPALSTAT/perfilesNacionales.asp?idioma=e*

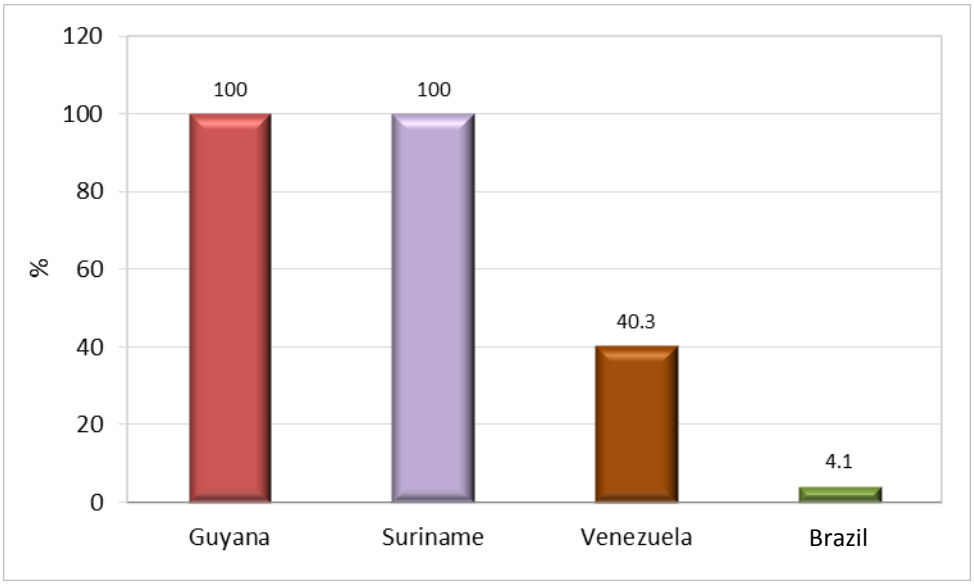
(6) ECLAC, 2015, at *http://interwp.cepal.org/cepalstat/WEB_CEPALSTAT/perfilesNacionales.asp?idioma=e*

GDP values per administrative unit are for reference only. They were estimated on the basis of the national GDP (ECLAC); this value was weighted with the information available on the relative contribution of each administrative unit to the national GDP, based on different sources and years. In the case of Venezuela, there was no information available about the GDP of its administrative units; therefore, for estimation purposes, the relative contribution of the enterprises in each administrative unit to the national total figure was used.

The sum of GDPs of the administrative units in the Hub accounts for 11.6% of the total of their economies, a very low figure explained by the fact that this Hub, except for the Capital District (Caracas) in Venezuela, includes only a small portion of Brazil, specifically of the states in the northern region, which are the least developed of the nation, while in the case of Venezuela, one of the largest industrial areas, the state of Zulia, is outside its scope.

If the administrative units' relative contribution to the Hub's GDP vis-à-vis their respective total national contribution is analyzed (**Figure 5.1**), Guyana and Suriname contribute 100% of their economies to the Hub, whereas Venezuela contributes a considerable percentage of its GDP, namely 40.3%, being the country that contributes the most to the economic strength of the Hub. Brazil, on the contrary, contributes only 4.1% of its GDP, being thus a minor contributor in view of its wealthier national economy.

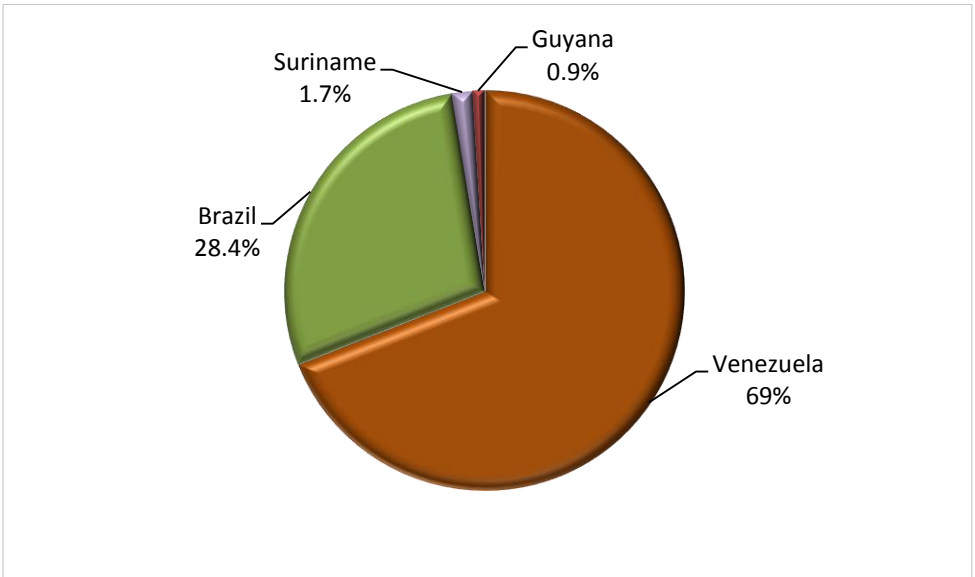
Figure 5.1: Relative Contribution of the AUs to the Hub's GDP vis-à-vis the Total Economy of Each Country



Source: Prepared by the author on the basis of the figures in Table 5.1

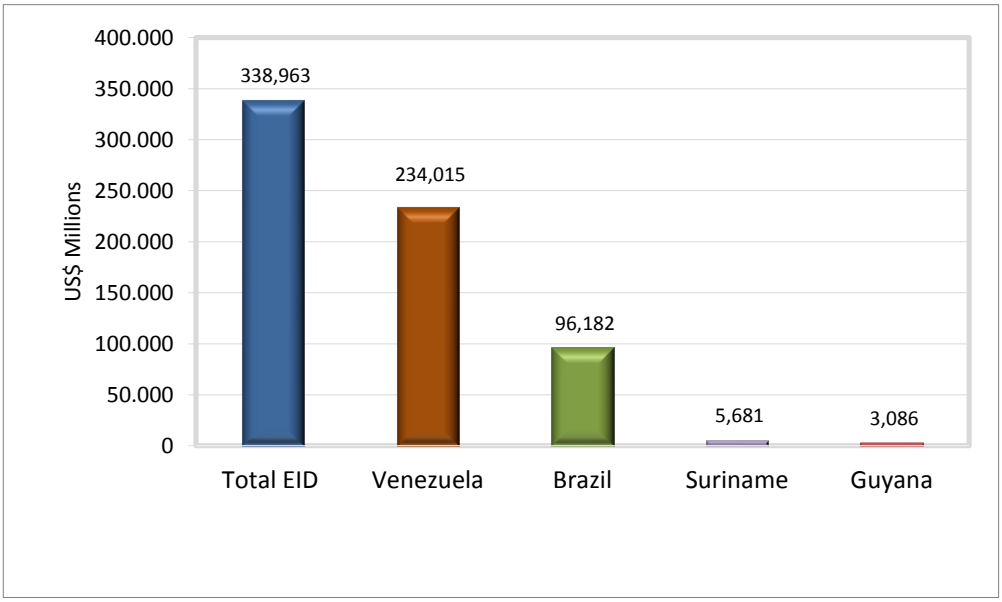
In considering the relative contribution to the GDP of the Hub by country, a very uneven picture comes up: Venezuela contributes with 69% to the Hub's GDP, thus being the country that contributes the most to the economic strength of the Hub; Brazil ranks second, as it contributes 28.4% to the Hub's GDP, a percentage that might be deemed low if compared to the size of its economy, but which is still significant in the context of this Hub, given its nominal size. The joint contribution of Guyana and Suriname to the Guianese Shield Hub's GDP is far lower, only 2.6% (**Figures 5.2 and 5.3**)

Figure 5.2: Relative Contribution to the Hub's GDP by Country Involved
(Total: US$ 575,422 million)



Source: Prepared by the author based on the data in Table5.1

Figure 5.3: Nominal Contribution to the Guianese Shield Hub's GDP by Country Involved
(Million US$)



Source: Prepared by the author based on the data in Table 5.1

A description of the economic structure of the countries involved in the Hub can be made by analyzing their national accounts (**Table 5.2**), an analysis that should be taken only as a reference, since the values supplied concern each country as a whole and are not exclusive to the administrative units comprised within the Hub. In the case of Guyana and Suriname, the data provided is accurate, since their entire territories are comprised within the Hub.

Table 5.2: Distribution of the GDP in the Guianese Shield Hub, by Country and Economic Activity

Country	Economic Activity (Million US$ at current prices)									
	Agriculture		Mining and Quarrying		Industries		Services[6]		Total	
	Nominal	%	Nominal	%	Nominal	%	Nominal	%	Nominal	%
Brazil	111,467	5.6	79,924	4.0	218,781	10.9	1,594,814	79.5	2,004,986	100
Guyana	574	21.1	472	17.3	97	3.6	1,580	58.0	2,723	100
Suriname	452	9.0	255	5.1	975	19.3	3,367	66.7	5,049	100
Venezuela	12,880	5.7	64,617	28.4	30,966	13.6	119,058	52.3	227,521	100
Total	**125,373**	**5.6**	**145,268**	**6.5**	**250,819**	**11.2**	**1,718,819**	**76.7**	**2,240,279**	**100**

Source: ECLAC, Cepalstat. *http://www.cepal.org/*
Note: The data reported by ECLAC correspond to different years depending on the country: Brazil 2014, Guyana 2013, Suriname 2014, and Venezuela 2010

In all cases, the contribution of services to the GDP is high to very high, accounting, on average, for about 64% of each country's GDP. Brazil's contribution is particularly high.

Brazil presents an unbalanced economy, as services account for almost 80% of its GDP, thus reflecting a strong tendency towards the satisfaction of people's needs through service provision and/or public employment, taking into account that the size of its public administration is the largest in the Hub and in the South American continent, equivalent to a 34% share of its GDP.[7]

Guyana is characterized by its poor industrial development, as this economic sector represents only 3.6% of its GDP, whereas the contribution of agriculture and mining to its economy is high, amounting to about 21% and 17%, respectively, thus making it evident that it is essentially a raw material producing country.

In **Suriname**, the industrial sector stands out, as it is the most important when compared against the other countries' industrial sectors, as it accounts for 19.3% of its GDP, followed by a significant agricultural sector, representing 9% of its GDP, again the largest in the Hub -all this showing that its economic structure is more balanced than that of the other nations involved in the Hub.

Venezuela is, by far, the country in the Hub that makes the highest contribution through the mining and quarrying sector, mainly because of its production of oil and its derivatives. In addition to this, the country features a high industrial development, accounting for more than 13% of its GDP.

With regard to the aggregate performance of the countries' major economic sectors (**Table 5.3**),[8] the following can be mentioned: Brazil ranks first in all the economic sectors present in the Hub; no matter that its contribution vis-à-vis the size of its economy is low, it is nominally so high that it far exceeds that of the other countries, to the point that even in the least significant sector, i.e. mining and quarrying, its contribution to the Hub's total for this sector amounts to 55%. Services represent the other extreme, as the Brazilian contribution to this sector accounts

[6] Under the services sector account, the following sub-accounts were considered: Public administration; financial intermediation; trade; transportation and communications; construction; and electricity, gas and water supply

[7] ECLAC, 2015. See *http://interwp.cepal.org/cepalstat/Perfil_Nacional_Economico.html?pais=BRA&idioma=english*

[8] Offered for reference only, as these data reveal each country's general performance (Table 5.3)

for almost 93% of the Hub's total. Only Venezuela has a significant share in the mining and quarrying sector, as it contributes 44.48% of the total. Guyana and Suriname contribute only marginally to all the accounts -their contributions do not exceed 0.5% in any sector.

Table 5.3: Relative Distribution of the GDP in the Guianese Shield Hub by Economic Activity (based on 2010 current prices)

Country	Economic Activities (% of the GDP)			
	Agriculture	Mining and Quarrying	Industries	Services
Brazil	88.91	55.02	87.23	92.79
Guyana	0.46	0.32	0.04	0.09
Suriname	0.36	0.18	0.39	0.20
Venezuela	10.27	44.48	12.35	6.93
Total	**100.00**	**100.00**	**100.00**	**100.00**

Source: ECLAC, Cepalstat. *http://www.cepal.org/*

If the territorial performance of the Hub's GDP is analyzed (**Figure 5.1**), the administrative units with more developed economies form a continuum from Brazil to Venezuela, which, although it may be seen as some sort of territorial homogeneity, responds to different phenomena. In the case of Brazil, it can be explained by a greater dynamism given by the transport flows that cross the states of Pará and Amazonas along the Amazon River towards Manaus and, from this city -which serves as a distribution center- towards various destinations in the Amazon basin. In the case of Venezuela, there is a group of administrative units associated with the production of oil and its derivatives with a strong presence of industries and agriculture, as can be seen in **Table 5.3**, whose data, although national, are clearly reflected in this group of administrative units.

On the opposite side, there is another group of poorly performing administrative units: they are located in the least developed states of Venezuela, such as Delta Amacuro, in the Orinoco delta, and extend towards the east into the whole territories of Suriname and Guyana, and into the Amazon region through the Brazilian states of Roraima and Amapá, all of them with a GDP lower than US$ 5,000 million.

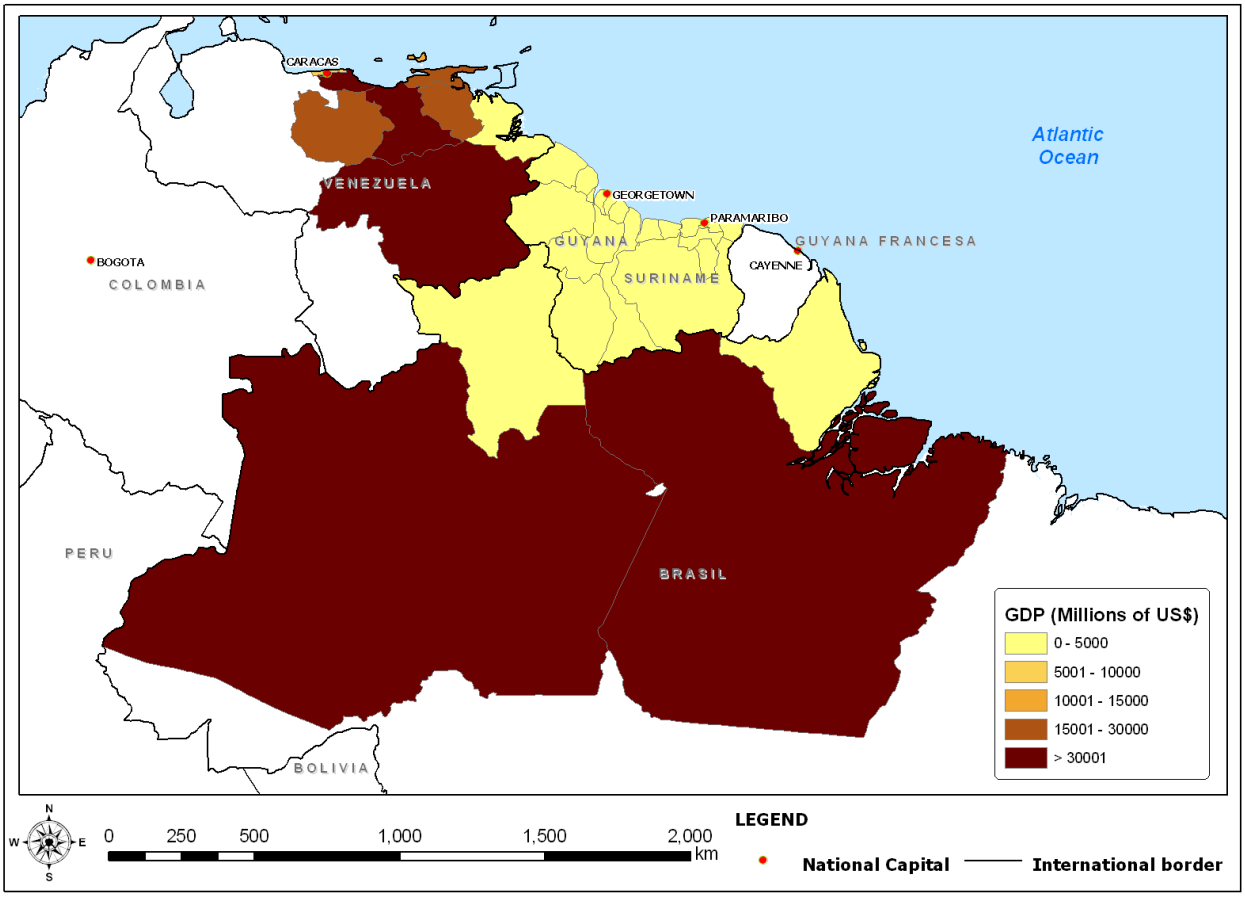
With the purpose of showing the tendencies observed in the economies involved in the Hub, Table 5.4 offers a compilation of the GDP growth rates in the 2007-2014 period. Overall, such data show the impact that the 2008 global economic crisis had on all the countries, which was strongly felt in 2009, with negative rates in at least two countries involved in the Hub, substantial falls in the other two, and a modest growth rate of 0.73%, on average, for the Hub that year.

The situation of Guyana and Suriname is more stable, showing a markedly positive tendency in the period under analysis, whereas Brazil and Venezuela have had a high degree of volatility in terms of economic growth and clear signs of deceleration in recent years: Brazil has undergone a substantial fall since 2011, reaching only 0.1% of GDP growth in 2014, and Venezuela has been declining to negative figures, reaching -4.0% that same year. In the case of Venezuela, one of the reasons for this sharp fall in the last three years has been the declining price of oil, an essential component of the Venezuelan economy, which according to the national accounts, contributes 29% in the mix of economic sectors.[9] In the Brazilian case, the sustained decline in

[9] ECLAC, 2015. See *http://interwp.cepal.org/cepalstat/Perfil_Nacional_Economico.html?pais=VEN&idioma=english*

the oil price plus a similar tendency towards a sharp fall in the soybean price are the main reasons for this constant fall in growth rates.

Figure 5.1: Territorial Distribution of the Guianese Shield Hub's GDP



Source: Prepared by the author

Table 5.4: Annual Variation of GDP in the Countries Involved in the Guianese Shield Hub (at 2010 constant prices)

Country	2007	2008	2009	2010	2011	2012	2013	2014
Brazil	6.0	5.0	-0.2	7.6	3.9	1.8	2.7	0.1
Guyana	7.0	2.0	3.3	4.4	5.4	4.8	5.2	3.9
Suriname	5.1	4.1	3.0	5.2	5.3	3.0	2.9	3.4
Venezuela	8.8	5.3	-3.2	-1.5	4.2	5.6	1.3	-4.0

Source: ECLAC, Cepalstat. *http://www.cepal.org/*

Table 5.5 shows the exports among the countries involved in the Hub, based on IDB-INTAL system information, DataINTAL. It can be seen that, in general, Brazil accounts for approximately 93% of the exports among the Hub's countries, while the other nations reach similar export rates of about 2.5% of the total export figures. In particular, Venezuela is the main destination of such exports, as it absorbs almost 94% of the total.

Table 5.5: Exports among the Countries Involved in the Guianese Shield Hub as of 2013
in US$ Million

Country	Brazil	Guyana	Suriname	Venezuela	Total
Brazil		24,468	45,957	4,632,081	4,702,506
Guyana	3,865		10,822	110,448	125,135
Suriname	3,542	119,160		324	123,026
Venezuela	102,564	7,357	606		110,527

Source: IDB-INTAL, DataINTAL[10]

Regarding total imports among the countries within the Hub (**Table 5.6**), Venezuela absorbs 74% of the goods exported from the other countries. It should be noted that almost all this merchandise comes from Brazil, its main trade partner within the Hub. Venezuela is followed by Brazil, which absorbs about 21% of the merchandise exported by its trade partners within the Hub, almost all of which comes from Venezuela. On the other hand, Guyana is the nation with the lowest import rates, as it absorbs only 4%, represented by a mix of products from its three trade partners within the Hub, the most important ones originating in Venezuela.

Table 5.6: Imports among the Countries Involved in the Guianese Shield Hub as of 2013
In US$ Million

Country	Brazil	Guyana	Suriname	Venezuela	Total
Brazil		2,853	1,073	1,174,117	1,178,043
Guyana	23,468		24,694	177,279	225,441
Suriname	38,926	8,807		14,082	61,815
Venezuela	4,227,361	1,529	10		4,228,900

Source: IDB-INTAL, DataINTAL [10]

The trade balance, i.e. the difference between the exports and imports of any given country, is shown in **Table 5.7,** in which it can be seen that Brazil has a positive balance with all the countries and that its main trade partner is Venezuela; Guyana has a negative balance and this is because it is basically an importer of merchandise from its partners within the Hub, while Suriname has a positive balance, mainly owing to the volume of goods exported to Guyana, its main trade partner; finally, Venezuela has a negative trade balance as a result of its imbalances with Brazil, its main trade partner within the Hub.

Table 5.7: Trade Balance among the Countries Involved in the Guianese Shield Hub as of 2013
In US$ Million

Country	Brazil	Guyana	Suriname	Venezuela	Total
Brazil		21,615	44,884	3,457,964	3,524,463
Guyana	-19,603		-13,872	-66,831	-100,306
Suriname	-35,384	110,353		-13,758	61,211
Venezuela	-4,124,797	5,828	596		-4,118,373

Source: IDB-INTAL, DataINTAL [10]

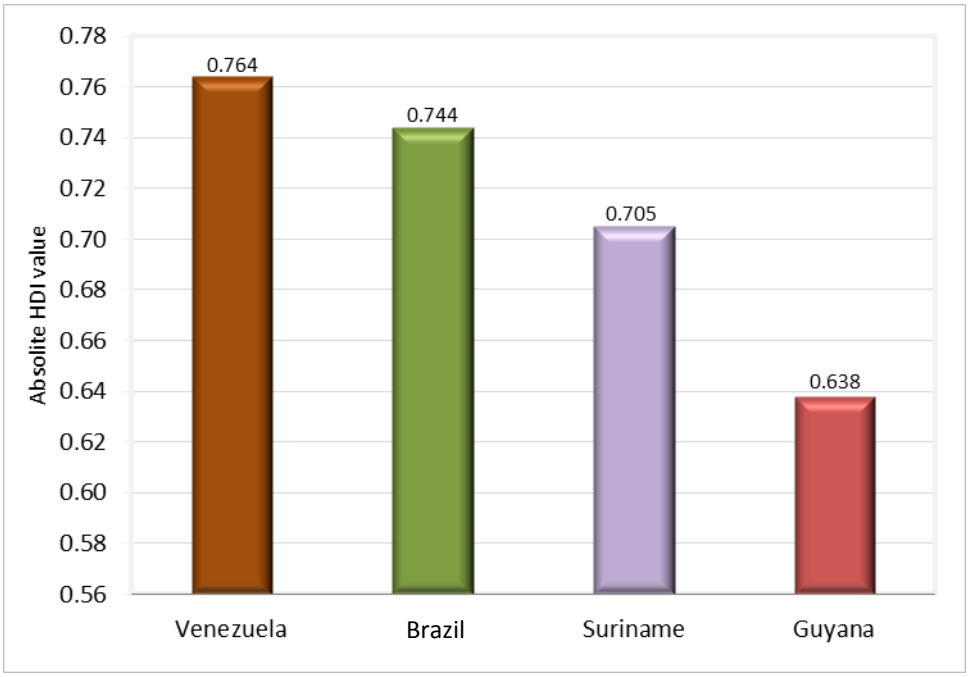
[10] IDB-INTAL, Inter American Development Bank, DataINTAL *http://www10.iadb.org/dataintal/CnsConsultaRapida.aspx*

6. SOCIAL ASPECTS

The social characterization of the Guianese Shield Hub is based on the Human Development Index (HDI),[11] which is a summary measure of the human development achieved by a given society. The index measures the average progress attained in three basic dimensions: long and healthy life, access to education, and a decent standard of living.

Overall, Venezuela, Brazil and Suriname belong, in relative terms, to the group of nations with a high HDI in the world context; however, the first two nations are quite apart from their partners in the Hub, since in absolute terms, they are in a better condition. Guyana is in the worst condition and among the nations having a medium HDI value (**Figure 6.1**).

Figure 6.1: HDI by Country in the Guianese Shield Hub

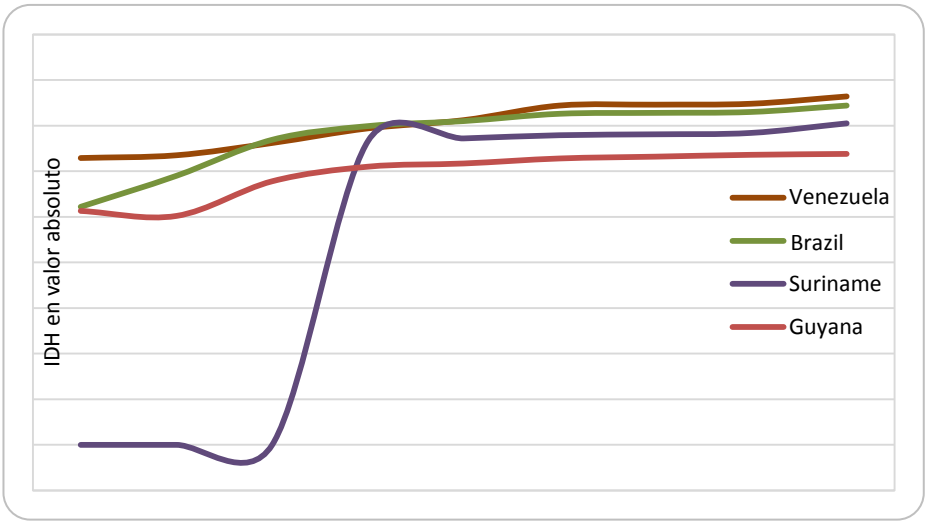


Source: Prepared by the author based on data in Table 6.1

The report available as of 2014 (UNDP, 2014, *op. cit.*) shows that the four countries in the Hub have made a sustained progress in HDI terms between 1980 and 2013 (**Figure 6.2**), but when the data in the series are compared, declining rates are observed, with minor progress between 2010 and 2012 in Venezuela, Brazil and Guyana, whereas Suriname's values are higher in this period. This phenomenon, common to all the countries with an HDI climbing up to higher positions, reveals that their potential HDI growth is halted under the appearance of a mere tendency if no additional efforts are made to give a new impulse to development.

[11] UNDP, 2014. Summary. Human Development Report 2014. Sustaining Human Progress: Reducing Vulnerabilities and Building Resilience. New York. See *http://hdr.undp.org/sites/default/files/hdr14-summary-en.pdf*

Figure 6.2: Evolution of the HDI between 1980 and 2012 in the Countries Involved in the Guianese Shield Hub



Source: UNDP. Human Development Report 2013. The Rise of the South: Human Progress in a Diverse World. New York, 2013

If the HDI is adjusted for inequality,[12] Venezuela, Brazil and Suriname move back ten, sixteen and six positions, respectively, while Guyana moves ten positions forward, revealing that although the country is generally below the standards of the other countries in the Hub, it is more balanced in terms of human development.

The data included in **Table 6.1** and **Figure 6.1** show a ranking whereby the information by administrative unit is organized in the same categories as the HDI in the world report -very high, high, medium, and low-, estimated by dividing the range of values attained by a country in the four categories.

If each country is analyzed in terms of the performance of its subnational administrative units (**Table 6.1** and **Figure 6.1**), Brazil, despite its high HDI as a country, presents a very different situation when focusing on the four states[13] involved in the Hub: the two smaller states, Roraima and Amapá, have a high HDI, which can be explained because their smaller territories offer better conditions to set up new infrastructure and to provide basic services as well as mechanisms to assist the settlement of the population. Instead, the Amazonas and Pará states, among the largest in the country, have more limited conditions for population settlement and to provide educational, health and infrastructure services, which are directly related to the achievement of a higher HDI; hence, their medium and low positions, respectively.

These results match, in part, the global map of economic development of Brazil, which considers this portion of the national territory, i.e. the northern region, as the country's least developed segment, contributing only 5.3% to the national GDP in 2010.[14]

[12] The inequality-adjusted HDI (IDHI) can be interpreted as the actual level of human development, since the difference between the HDI and the IHDI, expressed as a percentage, is the loss to human development due to inequality

[13] UNDP Brazil. Atlas do desenvolvimento humano no Brasil. At *http://atlasbrasil.org.br/2013/consulta* visited on October 17, 2013

[14] IBGE. Contas Regionais do Brasil 2010. Contas Nacionais N°30. Rio de Janeiro, 2012

Table 6.1: Human Development Index (HDI) in the Subnational AUs of the Guianese Shield Hub

COUNTRY	Type of AU	Name	HDI Ranking (by AU) (5)	HDI Level (6)	Country's HDI (7)	Country's Position in the World's HDI Ranking in 2013 (8)
Brazil (1)	State	Amapá	12	High	0.744	79 (High)
		Amazonas	18	Medium		
		Pará	24	Low		
		Roraima	13	High		
Guyana (2)	Region	Barima-Waini	1	Medium	0.638	121 (Medium)
		Cuyuni-Mazaruni	1	Medium		
		Demerara-Mahaica	1	Medium		
		East Berbice-Corentyne	1	Medium		
		Essequibo Islands-West Demerara	1	Medium		
		Mahaica-Berbice	1	Medium		
		Pomeroon-Supenaam	1	Medium		
		Potaro-Siparuni	1	Medium		
		Upper Demerara-Berbice	1	Medium		
		Upper Takutu-Upper Essequibo	1	Medium		
Suriname (3)	District	Brokopondo	1	Medium	0.705	100 (High)
		Commewijne	1	Medium		
		Coronie	1	Medium		
		Marowijne	1	Medium		
		Nickerie	1	Medium		
		Para	1	Medium		
		Paramaribo	1	High		
		Saramacca	1	Medium		
		Sipaliwini	1	Medium		
		Wanica	1	Medium		
Venezuela (4)	State	Anzoátegui	6	High	0.764	67 (High)
		Bolívar	5	High		
		Capital District	1	Very High		
		Delta Amacuro	24	Low		
	F.Dependencies	Federal Dependencies	N/D	N/D		
	State	Guárico	19	Low		
		Miranda	2	Very High		
		Monagas	14	Medium		
		Nueva Esparta	3	Very High		
		Vargas	9	Very High		
		Sucre	18	Medium		

(1) Human Development Atlas. *http://www.pnud.org.br/atlas/ranking/Ranking-IDHM-UF-2010.aspx*

(2) No studies on the HDI in the regions of Guyana were conducted; therefore the country's HDI was applied to all of them

(3) No studies on the HDI in the Surinamese districts were conducted; therefore, the country's HDI was applied only to the capital, where most of its population lives and where most of its GDP is produced. The other districts of the country, characterized by a scarce population, low population density and low GDP, were included in the medium HDI category, according to the author's criterion

(4) UNDP, 2002. Venezuela Human Development Report 2002. *http://hdr.undp.org/sites/default/files/venezuela_2002_es.pdf*

(5) It shows the relative position of the administrative unit in the context of its country

(6) The comparison among countries in these categories (very high, high, medium, and low) is only indicative, since the information is drawn from reports drafted in different years and some countries have introduced adjustments to the methodology used

(7) UNDP, 2014. Human Development Report 2014. Sustaining Human Progress: Reducing Vulnerabilities and Building Resilience. See *http://hdr.undp.org/sites/default/files/hdr14-summary-en.pdf*

(8) Relative position among 187 nations in the world. *http://hdr.undp.org/sites/default/files/hdr14-summary-en.pdf*

In Guyana and Suriname, no studies on the HDI at the subnational administrative unit level were carried out; therefore, it is not possible to compare the situation among them. For referential purposes, the HDI at country level was made extensive to all of them.

In Venezuela, there prevails a wide range of situations: the state of Miranda and the Capital District present a very high HDI, which correlates with a dense population and a high economic activity level (behind the state of Zulia), all these variables resulting in better educational and health service provision together with greater employment opportunities. The state of Vargas belongs to the same very high HDI category and, even though it is less populated and has a weaker economic activity; it forms part of a geographic continuum with the states just described. The Nueva Esparta state is also included in the group of administrative units having a very high HDI, and even if it does not form part of the geographic continuum of the previously mentioned states, they all share a common pattern: their location on the Caribbean Sea coast.

Also in Venezuela, the administrative units in the worst condition, i.e. with a low HDI, are Guárico and Delta Amacuro, both sparsely populated, the former almost to the extreme. The Venezuela Human Development Report 2002 analyzed the evolution of this indicator in the subnational administrative units over the 1991-1999 period, and showed the declining conditions of these two states: a progressive fall from the high and medium levels, respectively (according to the classifications in such study), to the medium and low categories in 1999. According to this report, it is as if two countries coexisted in Venezuela, one located in the central-northern coastal region, presenting the best opportunities and potentialities (Miranda, the Capital District, Nueva Esparta, Anzoátegui, and Zulia, among others), and another one, spread throughout the rest of the national territory, particularly in the rural areas highly populated by indigenous communities, relatively isolated from the center and with less opportunities (Delta Amacuro, Guárico, and Sucre, among others).[15]

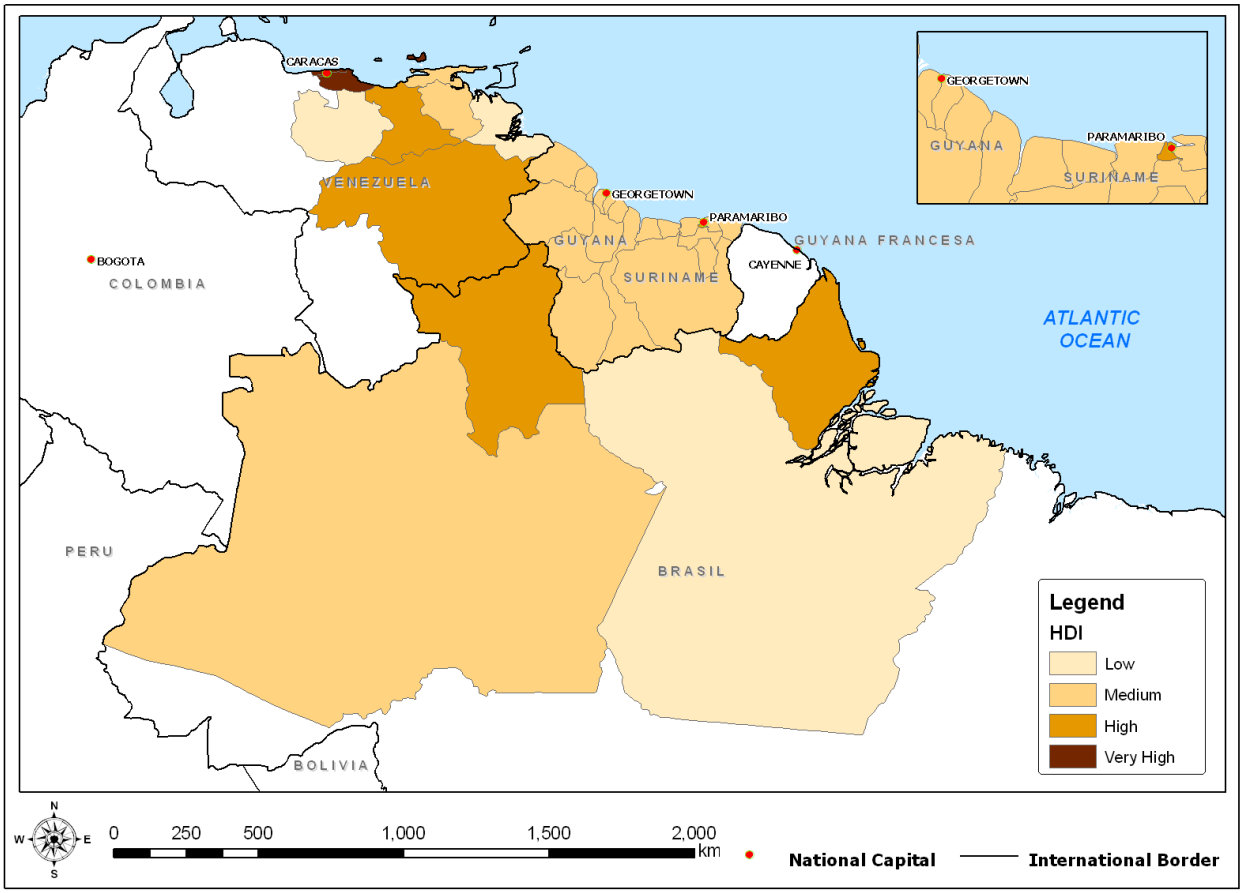
As a conclusion to this analysis, it may be said that the HDI offers a general picture of human well-being globally achieved by the countries, and that the set of nations included in the Guianese Shield Hub present diverse categories: from high-IDH countries, as is the case of Venezuela, Brazil and Suriname, to a medium HDI for Guyana, the country of the group with the least human development.

Similarly, when analyzing specifically each country, it can be observed that there are groups of administrative units in a similar condition: a high HDI, as in the case of Venezuela, associated with high levels of economic activity and population or with the fact that the capital city is included, as is the case of the Venezuelan Capital District, or else a medium or low HDI, as in the vast territories of the states of Pará and Amazonas in Brazil.

This lack of balance in terms of the HDI among the different subnational units that form part of the Guianese Shield Hub reveals the challenges and opportunities for the community of UNASUR Member States to make the most of the infrastructure and energy integration process as a vector for the promotion of human development in the territories of the continent where it is lower.

[15] UNDP, 2002. Venezuela Human Development Report 2002. *http://hdr.undp.org/sites/default/files/venezuela_2002_es.pdf*

Figure 6.1: Territorial Distribution of the HDI in the Guianese Shield Hub



Source: Prepared by the author based on the information in Table 6.1

7. ENVIRONMENTAL ASPECTS

At present, there are about 125 territorial units in the Hub with some degree of environmental protection, covering approximately an area of 950,000 km^2, a significantly vast territory as it accounts for about 60% of the total area of the Hub. A large part of this area is made up of vast natural reserves in southern Venezuela, equivalent to 470,000 km^2 of woody areas and wild rainforest.

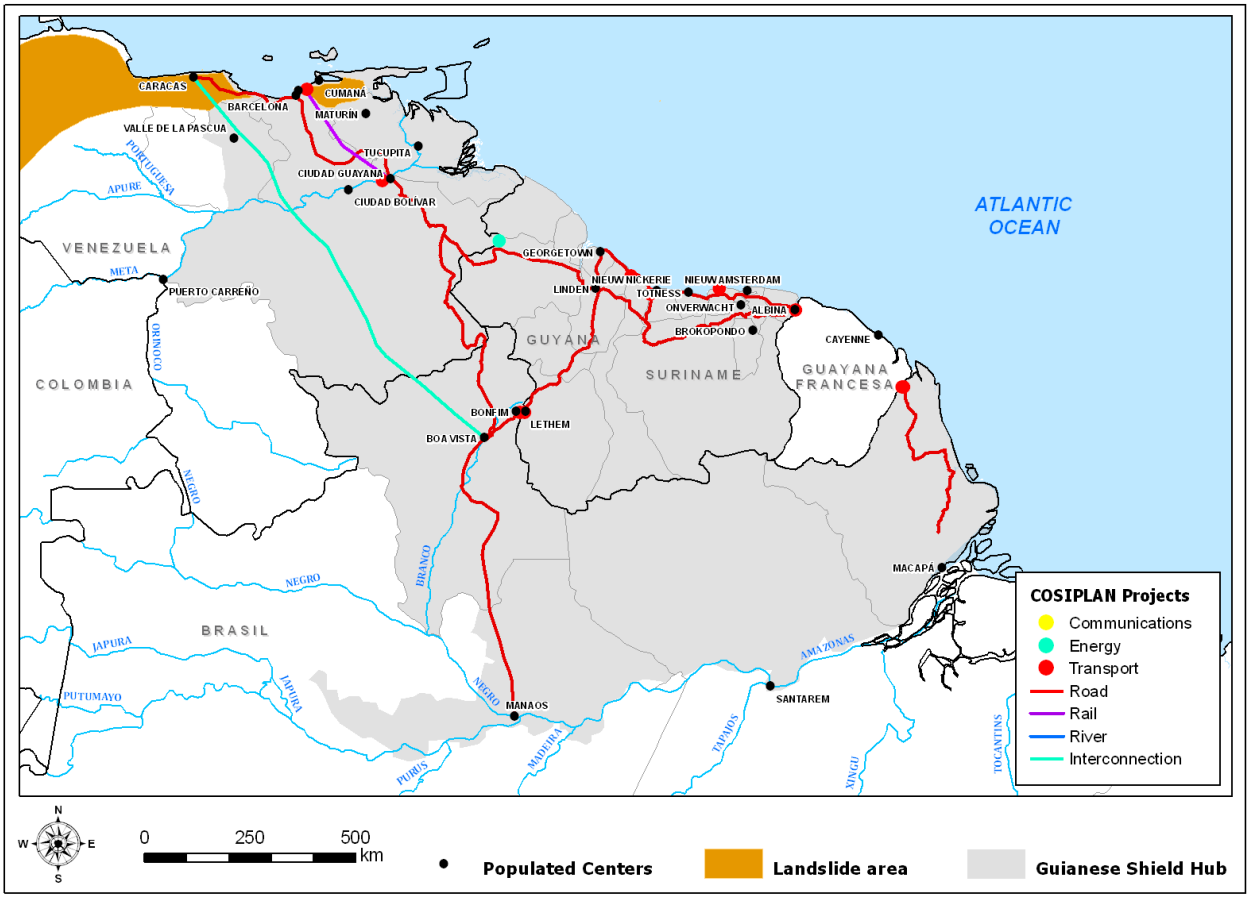
With reference to their relationship with the infrastructure projects included in the COSIPLAN Portfolio, the protected areas that relate to COSIPLAN projects because of their proximity and their potential to be environmentally impacted as a result of project implementation have been identified. Given the volume of the information used as a source and the fact that the map is for reference purposes, only the areas less than 10 km away from the location of the projects have been selected (**Table 7.2** and **Figure 7.2**).

Table 7.2: Protected Areas in the Guianese Shield Hub related to COSIPLAN-IIRSA Projects

Country	Name	
Brasil	Caverna do Maroaga State Environmental Protection Area	Monte Roraima National Park
	Seringal Triunfo Preservation Area	Area of Relevant Ecological Interest for the Biological Dynamics of Forest Fragments Project
	Médio Rio Negro-Aturiá/Apuauzinho State Environmental Protection Area	Anauá National Forest
	Médio Rio Negro-Tarumã Açu/Tarumã Mirim State Environmental Protection Area	Caracaraí Ecological Station
	MD Rio Negro-Paduari/Solimões State Environmental Protection Area	Montanhas do Tumucumaque National Park
	Maracá Ecological Station	Viruá National Park
Guyana	Wilderness Reserve/Managed Resource Use Area Iwokrama	
Suriname	Peruvia Natural Reserve	RAMSAR Coppenamemonding Site
	Copi Natural Reserve	Coppename Monding Natural Reserve
	Wane Kreek Natural Reserve	Bigi Pan Multiple Use Management Area
	Mac Clemen Forest Reserve	North Commewijne – Marowijne Multiple Use Management Area
	Kaboeri Kreek Natural Reserve	Noord Coronie Multiple Use Management Area
	Nani Natural Reserve	Noord Saramacca Multiple Use Management Area
	Boven-Coesewijne Natural Reserve	
Venezuela	Canaima National Park	Laguna de Tacarigua National Park
	Protected Zone of Southern Bolívar State	Caracas Metropolitan Area Protection Zone
	La Paragua Forest Reserve	Cerro El Volcán Protective Zone
	San Pedro Forest Reserve	Turimiquire Massif Protective Zone
	Formaciones de Tepuyes Natural Monument	Chuspita River Protective Zone
	El Dorado – Tumeremo Forest Reserve	La Pereza Protective Zone
	Paisolandia Forest Reserve	Cuenca Alta y Media del Río Machengo Protective Zone
	Mochima National Park	Imataca Forest Reserve
	Guatopo National Park	El Caura Forest Reserve
	El Avila National Park	Canaima National Park declared World Heritage Site

Source: Prepared by the author based on UNEP, *http://www.unep-wcmc.org*

Figure 7.2: Protected Areas within the Guianese Shield Hub



Source: Prepared by the author based on UNEP, United Nations Program for the Environment. *http://www.unep-wcmc.org*

8. INDIGENOUS COMMUNITIES

The presence of indigenous communities is very significant in the territory of the Guianese Shield Hub, as they inhabit a great portion of its area. In general, rural communities are engaged in subsistence activities outside the region's formal economy, or as rural and mining salaried workers, and, in some cases, they engage in subsistence agriculture. Their way of life, which is sustainable in all cases, is constantly threatened by invasion of lands for forest extraction or by large-scale mining operations, which leads to the degradation of large expanses of woody areas and rainforest, jeopardizing their economic, social and cultural survival.[16]

Children and adolescents are among the most vulnerable groups, usually with significantly higher mortality and illiteracy rates than non-indigenous population.[17]

Regarding Venezuela, data from the 2011 census indicate that the country is inhabited by 725,141 descendants of indigenous communities, accounting for about 2.5 of the total population. Of the 51 native peoples reported in such census, 12 represent 90% of the indigenous population, the greatest in number being the Wayuu people, which account for 57.3% of the total, followed far behind by the Warao people, accounting for 6.7%. With less than 4%, other peoples include, though not limited to, the Kalina, the Pemon, the Anu, the Cumanagoto, the Piaroa, the Guahibo, the Chaima, the Yukpa, the Pumé, and the Yanomami. The other, non-identified peoples account for the remaining 9.5%. As for their geographic location, Zulia state stands out, with 61% of the indigenous population, followed far behind by the Amazonas state with 10.50%, Bolívar state with 7.54%, Delta Amacuro state with 5.73%, Anzoátegui state with 4.83%, and the states of Sucre, Monagas, and Apure, with less than 3.5% each.

According to the 2010 census, Brazil is inhabited by 896.917 descendants of indigenous communities,[18] approximately 600,000 of whom live in the so-called Indigenous Territories recognized by the Brazilian State. They total 230 peoples, which account for 0.5% of the country's total population. Their presence in the Hub's area is significant, mainly in the state of Roraima -where they are settled in approximately half of its area-, the northern portions of the states of Amazonas and, to a lesser extent, the state of Amapá.

In Guyana, on the basis of the 2002 census, there are 68,812 persons of indigenous descent, i.e. about 9% of the total population, belonging to the Akawaio, Arekuna, Kalina, Lokono, Macushi, Patamona, Wai Wai, Wapishana, and Warao peoples, which are called "Amerindians" in the domestic legislation to distinguish them from other foreign peoples who settled in the country as immigrants. The Wai Wai and Arekuna are the least in number, together amounting to fewer than 700 persons, while the Lokono are the most numerous Amerindians, with about 16,000 inhabitants. All these peoples have links with the indigenous communities inhabiting Venezuela, Brazil, and Suriname. Concerning their geographic distribution, most of them live in the Barima-Waini, Cuyuni-Mazaruni, Potaro-Siparuni, and Upper Takutu-Upper Essequibo regions.

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[16] Cruz, Alberto. *Pueblos originarios en América. Guía introductoria de su situación*. Pamplona: Aldea Alternatiba Desarrollo y Centro de Estudios para las Relaciones Internacionales y el Desarrollo

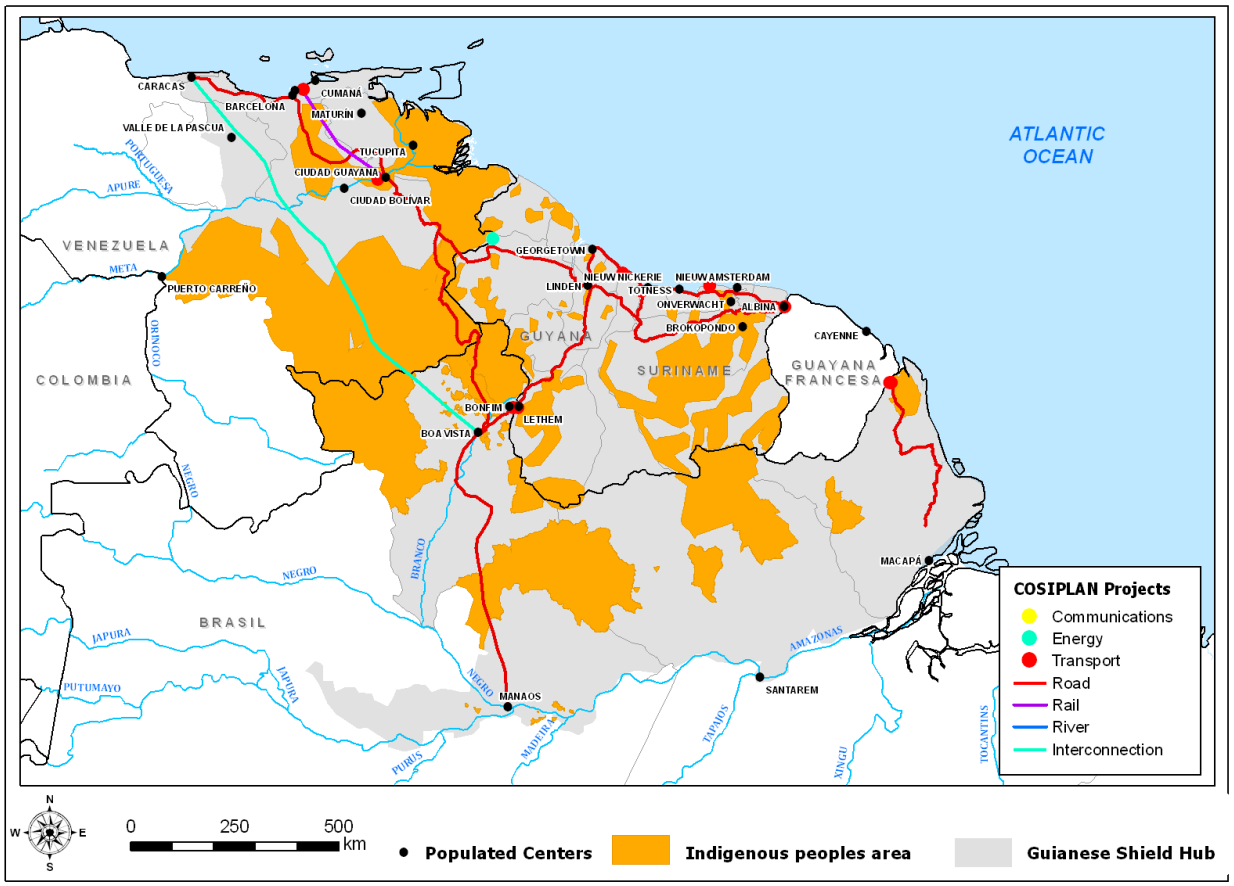
[17] Economic Commission for Latin America and the Caribbean (ECLAC). *Mortalidad infantil y en la niñez de pueblos indígenas y afrodescendientes de América Latina: inequidades estructurales, patrones diversos y evidencia de derechos no cumplidos.* Ana María Oyarce, Bruno Ribotta y Malva Pedrero. Chile, 2010

[18] Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics – IBGE). 2010 Census. *http://indigenas.ibge.gov.br/*

According to the 2004 census, Suriname's population size is 492,829 persons, some 39,426 of whom would be aborigines (belonging to the Akurio, Arawak or Lokono, Galibi, Mawayana, Sikiiyana, Trio, and Tunayana peoples) and maroons (from the Kwinti, Matawai, Ndyuka, Pamaka, and Saamaka groups), i.e. descendants of African slaves who escaped from plantations near the coast under Dutch colonial rule. The Akurio, Mawayana, Sikiiyana, and Tunayana indigenous peoples are practically extinct, as at the time of the census there were only around ten members of each. Among the Maroons, the Kwintis are the fewest in number, with a little over 500 members. Based on the census, one third of the Maroons live in Paramaribo, whereas most indigenous peoples still live in their ancestral lands.

Figure 8.1 shows an approximation of the areas with presence of indigenous communities in the territory of the Hub. Their size is for reference only, as in most of the cases they do not stand for the real areas but are the result of a cartographic generalization process to represent more than one community.

Figure 8.1: Indigenous Communities in the Guianese Shield Hub



Source: Prepared by the author

9. HAZARDS AFFECTING THE INFRASTRUCTURE OF THE HUB

According to the Organization of American States, natural hazards are those elements or phenomena of the physical environment, harmful to man and caused by forces extraneous to him, which because of their location, severity, and frequency, have the potential to affect humans, their structures, or their activities adversely. These may be atmospheric, hydrologic, and geologic (especially seismic and volcanic) phenomena.[19] The losses and impacts that characterize disasters usually have as much to do with the exposure and vulnerability of capital stock as with the severity of the hazard event.

In its "Global Assessment Report on Disaster Risk Reduction 2013,"[20] the United Nations Office for Disaster Risk Reduction (UNISDR) uses the term physical (rather than natural) hazard to refer to hazardous phenomena such as floods, storms, droughts and earthquakes. Processes such as urbanization, environmental degradation and climate change shape and configure hazards; therefore, it is becoming increasingly difficult to disentangle their natural and human attributes.

For the purpose of this characterization of the Guianese Shield Hub, four hazards -which, according to the UNISDR, are major hazards on account of their global and regional consequences, which could result in significant impacts on infrastructure, energy supply and distribution, and communications- have been considered, namely earthquakes, tsunamis and flooding in large basins, as well as landslides, which, though localized, are highly frequent and destructive.

For each of these hazards, a referential map has been created, showing the location of the hazards in the Hub's area of influence and their relation to COSIPLAN-IIRSA infrastructure.

In general terms, the territory of the Hub is mainly exposed to geodynamic hazards due to seismic movements, and to meteorological and hydrological hazards, produced by the heavy rainfall typical of the area. The Caribbean coastal strip is exposed to tsunamis caused by the eruption of submarine active volcanoes. Also generally speaking, the Caribbean coast is primarily affected by hydrometeorological hazards, such as large floods and landslides.

Landslide hazards affect all the areas of the Hub where there are great slope gradient differences and torrential rains associated with intervention in drainage basins such as unplanned settlements, land disturbances due to urban infrastructure works, and deforestation, among other factors.

9.1 Seismic Hazard

One of the most hazardous seismic hot spots in the territory of the Guianese Shield Hub is located at the north-northeastern end of the South American continent, affecting Venezuela because of its proximity and, to a much lesser extent, the other countries involved in the Hub. Such area is the so-called Pacific Ring of Fire, characterized by the collision of the South American plate and

[19] Organization of American States (OAS). 1991. "Disaster, Planning and Development: Managing Natural Hazards to Reduce Loss." Washington, D.C.

[20] United Nations Office for Disaster Risk Reduction (UNISDR). 2013. "Global Assessment Report on Disaster Risk Reduction." Geneva, Switzerland

the Nazca plate, which causes the sliding of the latter under the continent (subduction zone),[21] creating great pressures, energy accumulation, fractures, and seismic waves.

The strains generated by this collision are distributed and transmitted throughout the South American plate and cover all the Andes range, causing fractures or geological faults, which are the source of continental earthquakes. This is why almost 80% of volcanic and seismic activity on Earth is reported along the whole western slope of the continent, between Chile and Colombia (the latter bordering the territory of the Guianese Shield Hub).[22]

It is in this context that the seismic hazard to the Guianese Shield Hub arises, which is the probability that seismic vibrations with a given acceleration level vis-à-vis gravity will occur in a given region in a pre-established period of time.[23]

Figure 9.1 shows the level of seismic hazard in the area of influence of the Hub. It can be seen that the nearer to the coastal subduction zone -comprising all the administrative units of the Venezuelan Caribbean involved in the Hub-, the higher the seismic hazard level, and that this level gradually decreases as the distance to the inland of the continent increases.

The portion of the Venezuelan territory included in the Hub that is directly threatened by seismicity is inhabited by more than 9.6 million people living in the administrative units that have coasts on the Caribbean Sea -Anzoátegui, the Capital District, the Federal Dependencies, Miranda, Monagas, Nueva Esparta, Sucre, and Vargas-.

In addition to the human lives at risk, the country's main ports and oil refineries, urban infrastructure in big cities, and road connectivity would be affected due to the probability of earthquakes.

This area has been struck by a long series of earthquakes, the first of which were recorded back in the 17th century. Since 1900, at least 29 seismic movements of different intensity have occurred, affecting mostly the Andean region and the Caribbean coast. It is worth noting that in the last 15 years there has been at least one event each year.

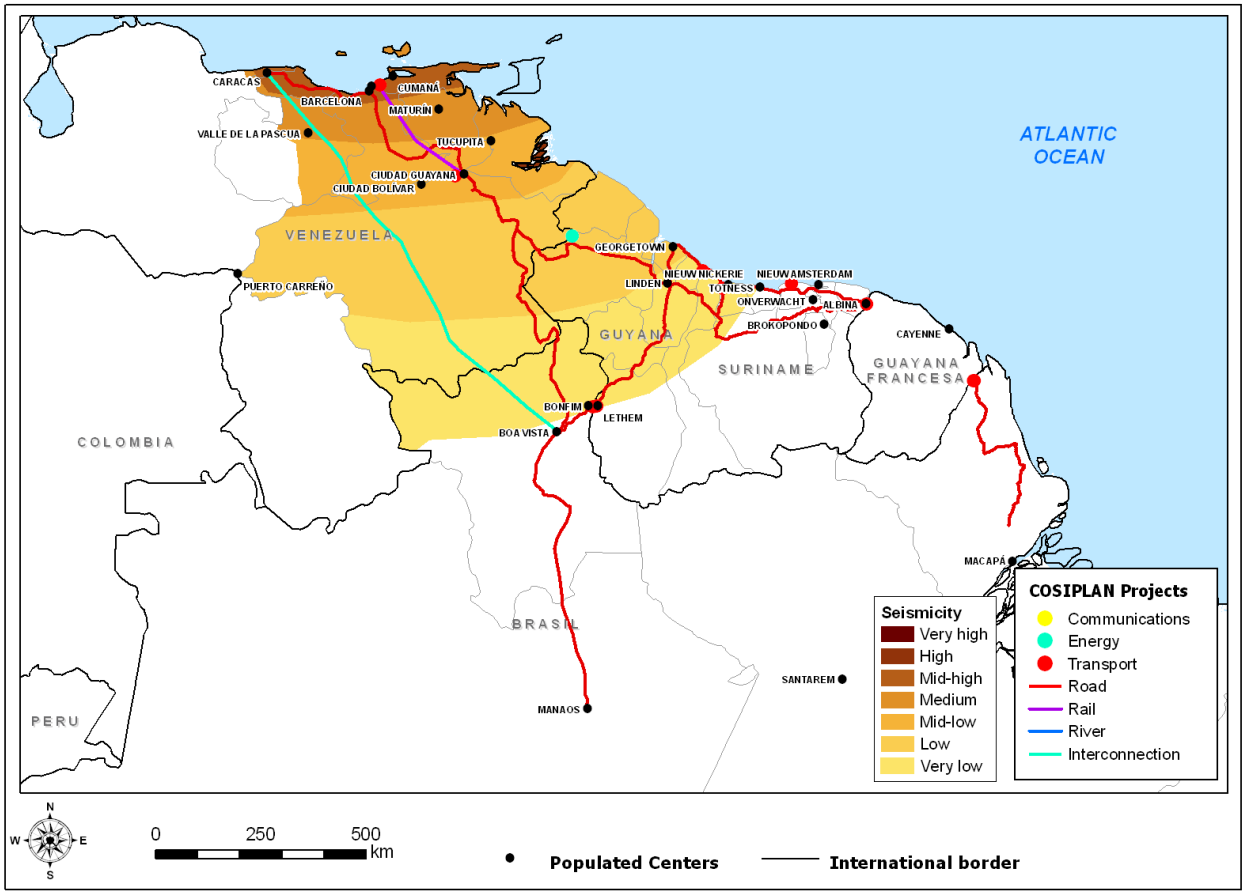
One of the greatest earthquakes recorded shook Caracas, Venezuela's capital city, in 1967, leaving 260 people dead and 2,000 injured, in addition to causing massive damage that included the city's architectural heritage. Other frequent hot spots are La Guaira, Carúpano, and the coasts in the state of Sucre.

[21] The Nazca plate moves eastward and is diving down under the South American plate, which moves westward, in a mechanism called "subduction." Both plates move at a relative speed of 11 cm/year

[22] United Nations Office for Disaster Risk Reduction (UNISDR). 2013. *América del Sur: Una visión regional de la situación del riesgo de desastres*. January

[23] PREDECAN Project. "Atlas de las dinámicas del territorio Capricornio: población y bienes expuestos a amenazas naturales." Visited on October 10, 2013 at *http://www.comunidadandina.org/predecan/atlasweb/index.html*

Figure 9.1: Seismic Hazard in the Guianese Shield Hub



Source: Prepared by the author based on data from the Regional Center for Seismology for South America (Centro Regional de Sismología para América del Sur – CERESIS)

9.2 Tsunami Hazards

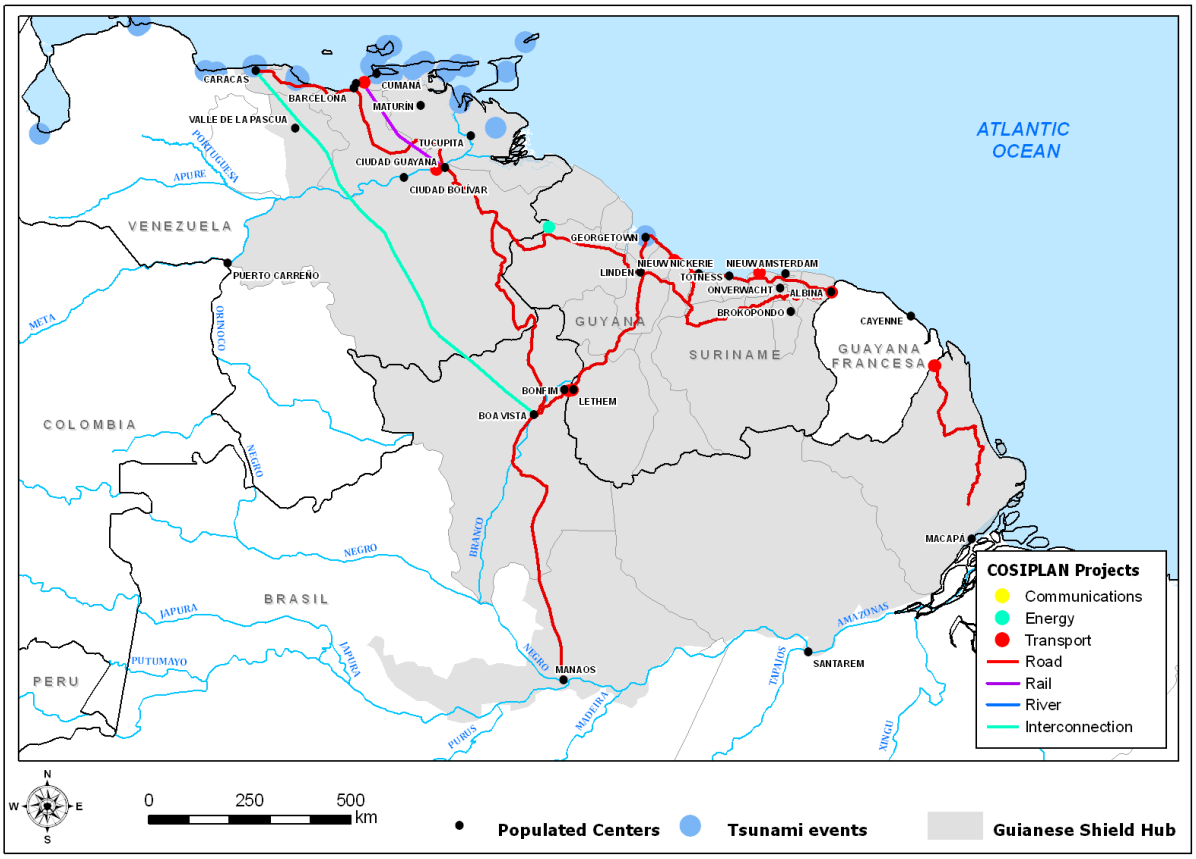
Tsunamis are caused by the rapid displacement of a body of water as a result of a sudden fracture in Earth's crust due to underwater earthquakes, landslides or volcanic eruptions, ice calving, or asteroid impacts. The term "tsunami" comes from the Japanese language and means "large harbor wave" (PREDECAN Project, 2013, *op. cit.*).

Almost all tsunamis reported in South America have been caused by earthquakes originating from the activity triggered by the collision of the Nazca and South American plates in the so-called subduction zone, although in the Caribbean they can also be generated by submarine eruptions.

Tsunamis are large-scale phenomena, far exceeding the Caribbean coast in the area of influence of the Guianese Hub. In fact, this hazard spans from 47°S, in Chile, to 7°N, in Colombia, where there is a fault and, consequently, a subduction zone running for 6,000 km and capable of producing the largest earthquakes in the world, with vertical crustal fractures and, therefore, a potential to displace large volumes of water.

In the Hub, tsunami hazards affect the coastal regions of the Venezuelan Caribbean, threatening the state of Anzoátegui, the Capital District, the Federal Dependencies, and the Miranda, Monagas, Nueva Esparta, Sucre, and Vargas states. This is primarily due to the presence of active submarine volcanoes, more specifically of Kick 'em Jenny, an active volcano located about 200 km off the Venezuelan coast. All this coastal section is home to important urban centers and port facilities that handle both general and special hydrocarbon and petrochemical cargo and, along with the refineries, represent the densest agglomeration of infrastructure in the Hub.

Figure 9.2: Tsunami Hazards in the Guianese Shield Hub



Source: Prepared by the author based on data from the US National Oceanic and Atmospheric Administration (NOAA) at *https://www.ngdc.noaa.gov/hazard/tsu_db.shtml*, visited in November 2015

9.3 Flood Hazards

A flood is an overflow of rivers caused by intense rainfall over a relatively short period of time exceeding the infiltration capacity of the soil/vegetation complex and its ability to contain rain runoff and allow it to normally flow along natural courses.

Flooding may grow worse given the changes in ecosystems as a result of the use of land for agriculture and husbandry, and of forest harvesting that leads to the depletion of the natural vegetation cover, with the consequent denudation of the soil, and even more by the construction of cities and infrastructure without adequate planning or consideration of its environmental impact and the risk of natural disasters.

Flooding may take long and cover vast areas during weeks or months, as is the case of the large drainage basins in the Hub (the Orinoco and Amazon basins), but it can also be highly intense, with peak flows in short periods of time, causing huge volumes of waters to flood cities that, in many cases, have been located or thrived in low-altitude or non-adequate areas.

In the Hub, the hazard of floods caused by bank overflow affects mainly the Amazon and Orinoco basins (**Figure 9.3**). The former covers 6,000,000 km^2 and, in the area of the Hub, includes territories in Brazil, southern Venezuela, Guyana, and Suriname. This hydrographic system has over 1,000 tributaries that flow into the Amazon River and out into the Atlantic Ocean. The Orinoco basin covers about 1,000,000 km^2, with 65% of it in Venezuela.

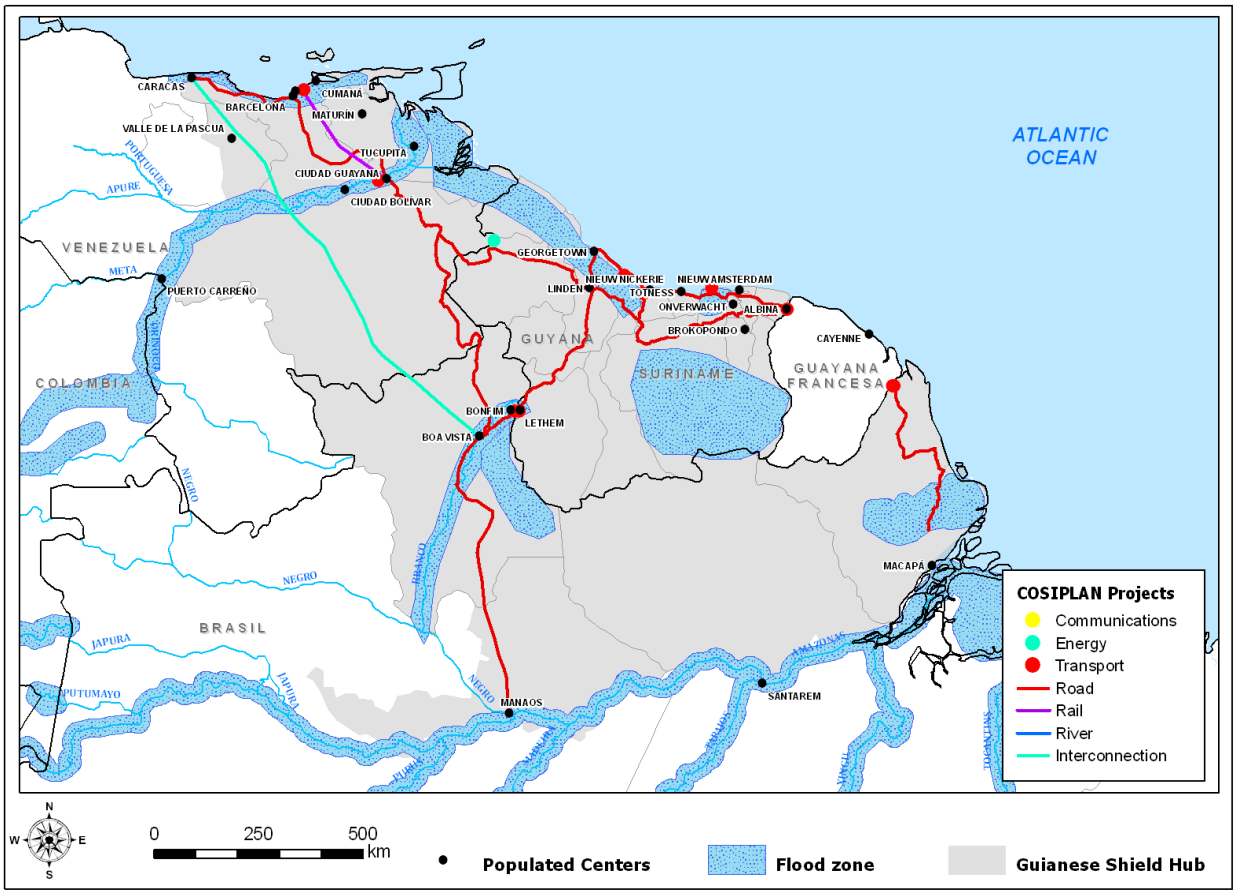
Heavy seasonal rains, falling primarily on the eastern Andes and on the northwestern portion of the basin, are responsible for the annual river level fluctuation. Because of the vast expanse of the Amazon basin and the uneven distribution of seasonal rainfall, different areas of the River system are flooded at different times of the year. This increase in the river flow rate results in the overflow of its banks and the flooding of the coastal areas, affecting small riverside villages as well as big cities like Manaus and port and connectivity infrastructure. The water covers areas up to some 20 km from the shore, and during the wet season, can reach heights of 7.5 to 15 m.

The Orinoco has regular rise and fall rates, reaching its maximum flow in August and its minimum flow in March. In Puerto Ayacucho, the average runoff is about 28,000 m^3/s in August and 5,000 m^3/s in March. In Ciudad Bolívar, the minimum water level height is 2.6 m.a.s.l. on average and occurs in mid-March, whereas the average maximum height is 16.2 m.a.s.l. and takes place by the end of August. Ciudad Bolívar experiences recurrent floods, which cause high material losses and affect mainly localities in the natural floodplain of the river.

It should be noted that there is another flood hazard in the territory of the Hub with distinct features: the flooding of urban areas as a result of heavy rainfalls that lead to considerable increases in the height of the rivers that cross them and to the collapse of urban drainage systems. These phenomena are recurrent in the coastal cities in northern Venezuela, some of them located on alluvial fans where rivers flow into the Caribbean Sea, and have become more frequent in the last few years. These events can be highly destructive, threatening the lives of thousands of people as well as the main urban and industrial infrastructure of the country. In Caracas, many residential areas have been built in hazard zones formed by the alluvial fans of the ravines and banks of the Guaire River, causing sizable urban floods.

In Guyana and Suriname, the highest intensity rainfalls occur between December and April, often leading to recurrent floods in coastal areas, especially in the coastal regions of Guyana - Essequibo Islands-West Demerara, Demerara-Mahaica, and Mahaica-Berbice, where the main urban centers of the country are located. There are recurrent floods also in the interior, as was the case in 2006, when torrential rains caused the Tapanahony and Lawa Rivers to overflow, affecting about 20,000 people. The situation is similar in Suriname, where this 2006 event, one of the largest floods in history, directly affected about 25,000 people, leading to the evacuation of whole villages in the country's hinterland.

Figure 9.3: Guianese Shield Hub's Flood Hazard Map



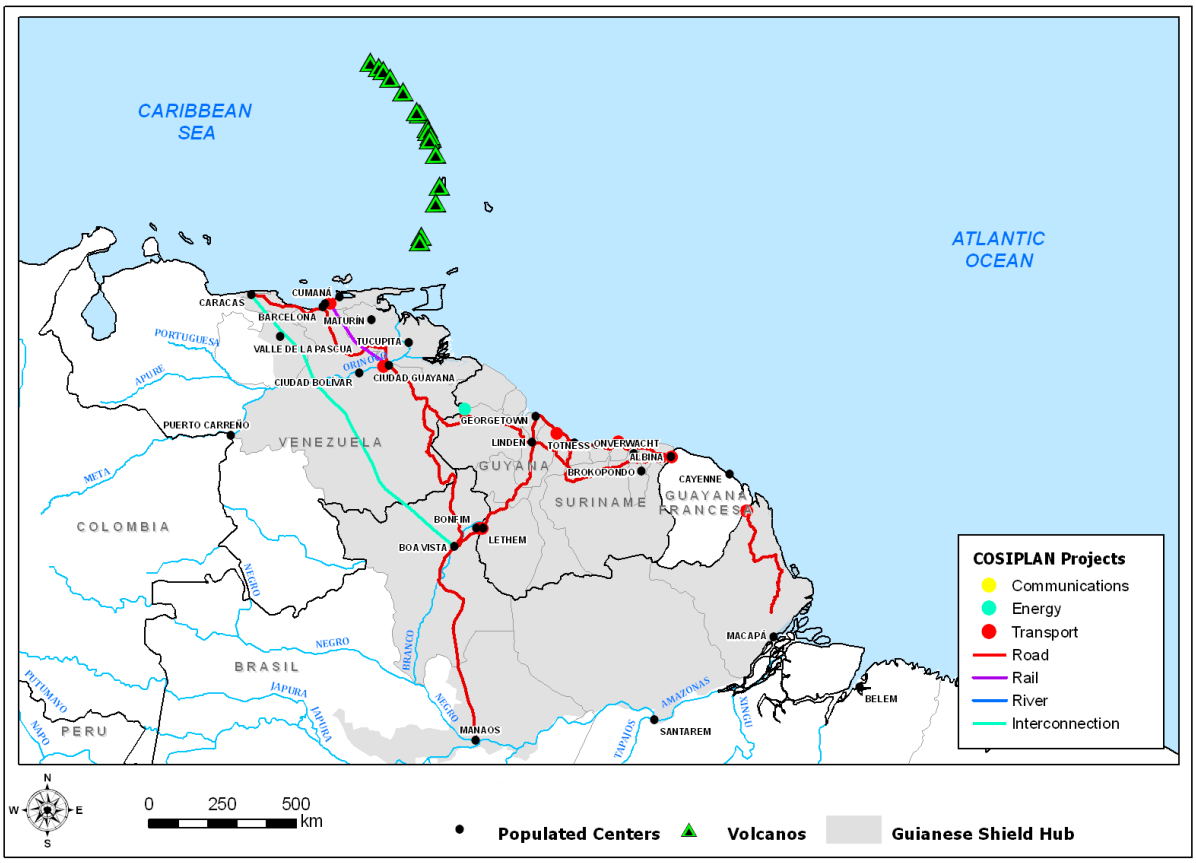
Source: Prepared by the author

9.4 Volcanic Hazards

Even though there are no volcanoes identified in the continental area of the Hub, it is worth noting, given its proximity, the presence of a network of volcanoes in the Antilles Arc originating from the collision of the North American and Caribbean tectonic plates. This volcanic chain is on the Caribbean Sea as a result of this collision, whereby the North American plate is pushed down beneath the Caribbean plate -on which most of these islands lie-, i.e. a subduction zone. The collision causes folds and fractures, the latter being used by magma -rock melted at very high temperatures- to go up to the surface. The Soufrière Hills, on the island of Montserrat, is the only active surface volcano, which last erupted on July 18, 1995, leaving Plymouth, the capital of the island, buried in ash. Another one of the 19 volcanoes present in the area is active, but this is a submarine volcano located on the sea floor approximately five nautical miles from the coast of Grenada -the Kick 'em Jenny, which has been the most active in years, with at least 12 eruptions since 1939, the latest one having taken place in 2001. Its eruption in 1965 generated a minor tsunami that reached the island of Barbados. **Figure 9.4** shows the geographic location of all the volcanoes in the area of influence.[24]

[24] Department of Mineral Sciences, National Museum of Natural History, Smithsonian Institution. Washington, D.C. Visited in November 2015 at *http://www.volcano.si.edu/*

Figure 9.4: Volcanic Hazards in the Guianese Shield Hub



Source: Prepared by the author based on data from Department of Mineral Sciences, National Museum of Natural History, Smithsonian Institution. Washington. D.C.

9.5 Landslide Hazards

Landslides or mass movements are a series of phenomena that include, among others, earthflows, the displacement of soil particles (debris flows), land subsidence, rock falls, and avalanches (both snowslides and rockslides) (PREDECAN Project, 2013, *op. cit.*). These are downward phenomena, as they are controlled by gravity and occur in high-energy environments, characterized by significant height differences, typical of foothill and plateau areas (DIPECHO, 2012, *op. cit.*).

These mass movements -or mass wasting- can be of two types: those resulting from debris that moves downslope along a fault or other plane of weakness, which are more frequent in wet areas, and those produced by extraordinary water-saturated debris flows along pre-established courses, which are more frequent in areas with short-term torrential rains.

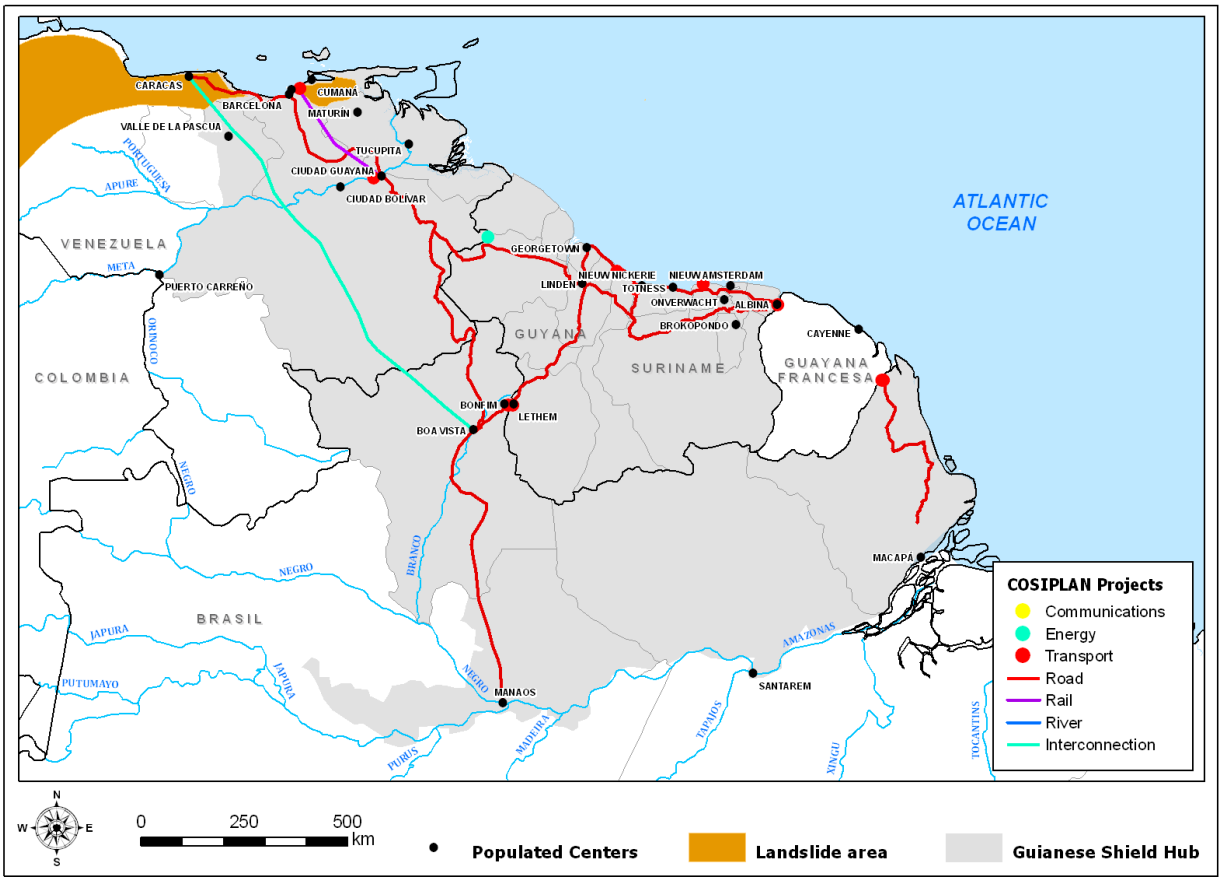
In addition to their natural causes, landslides are also aggravated by human activity, such as deforestation in the highest regions of a basin or more localized actions, like sidehill cuttings for building roads, settlements on alluvial fans, and the reduction of natural floodways complemented by a lack of efficient rainwater collection systems.

Figure 9.5 shows, for reference purposes, the areas that are most threatened by landslides in the Guianese Shield Hub, as estimated on the basis of data about recorded events.

As can be seen in the Figure, these types of hazards are primarily located in Venezuela's northern coastal area. On their way to the sea, these overland flows cause substantial damage to urban and road infrastructure, and even the isolation of small towns or villages.

In Venezuela, the administrative units that are more prone to landslides are those in the northern coastal region, including the state of Vargas and the Capital District. In addition to natural climatic phenomena causing heavy rains in short periods of time, this region features urban settlements on alluvial fans. The large masses of sediments and rocks dragged down higher land settle on the beds of the fans and obstruct them, which results in overflows and new water courses or channels extending in different directions from the apex of the fan. Flash floods and torrential avalanches are frequent in this area and pose a serious risk to the lives of the members of the communities settled here. A particularly devastating event of this kind took place in 1999 in the state of Vargas, hence its name "Vargas tragedy." After four days of unusually heavy rains (greater than 900 mm) that caused cracks in the hills, flash floods and debris flows destroyed whole towns and buried those located on alluvial fans under three meters of sediments. An accurate number of casualties has not been ascertained but, according to different sources, it was between 10,000 and 30,000. Approximately 75,000 people were displaced. Subsequent studies conducted by the U.S. Geological Survey established that the depositional volume of debris was 2,000,000 m^3.

Figure 9.5: Landslide Hazard Territories in the Guianese Shield Hub



Source: Prepared by the author

10. THE COSIPLAN-IIRSA PROJECT PORTFOLIO AND ITS LINKS WITH THE TERRITORY OF THE GUIANESE SHIELD HUB

The purpose of this chapter is to analyze the main limitations and opportunities that arise when a link is established between the infrastructure projected using the COSIPLAN-IIRSA Indicative Territorial Planning Methodology and the various components discussed in this report -the economy, social aspects, protected areas, indigenous communities, and hazards.

First, it should be noted that the Guianese Shield Hub features a low population rate in its territory (**Figure 3.1**), with a population density below 25 inhab./km^2, which is true for all the administrative units with the exception of the Venezuelan Caribbean coast and the Atlantic coastal area of Guyana and Suriname. While, overall, the territory is sparsely populated, in general inhabitants are concentrated in the capital cities of the administrative units or in some economic hubs such as the city of Manaus. In this regard, the environmental characteristics of the territory, where woody areas and impenetrable rainforest prevail, set particular conditions for human development that, along with some historical events, partially explain the concentration of the population.

The demographic and settlement patterns described above are linked to a limited, low-standard and underdeveloped connectivity infrastructure network. Only in the northern coast of Venezuela -which actually overlaps with other Hubs such as the Andean Hub- there is a greater density of roads, which is directly associated with a much more numerous population. Worth mentioning as well is the waterway development along the Amazon and Orinoco Rivers, which also overlap with or form part of the Amazon Hub.

The network of COSIPLAN-IIRSA projects in the Hub is mostly located in the central and the Caribbean and Atlantic coastal areas, as shown in **Figure 10.1**, which is clearly intended to strengthen and modernize the infrastructure fabric that provides a connection to the coastal cities, thereby gradually reinforcing the links between the production centers and the ports. In addition, the completion of the projects will result in connections between the most important cities in the Hub, such as Caracas-Manaus, Caracas-Georgetown-Paramaribo, and Manaus-Georgetown, to name only the most important ones.

As for the economic component, the Guianese Shield Hub features, among its administrative units and cities, important economic activity clusters such as the Manaus technological center, Caracas, and the coastal refineries of Venezuela. Furthermore, heavy industries concerned with aluminum and steel and their derivatives are significantly developed, which source their raw materials from territories within the Hub whose development is based on hydrocarbon and metal ore extraction.

In general terms, the Guianese Shield Hub faces great economic challenges. As mentioned in the paragraph above, the production of industrial goods has great economic potential for the territory, but it is not exploited to its fullest. The provision of a connectivity, energy, and communications infrastructure network would be instrumental in tapping into this potential.

When comparing the relative contribution of the countries and their administrative units to the economic activity in the Hub, Venezuela's administrative units and the Brazilian states of

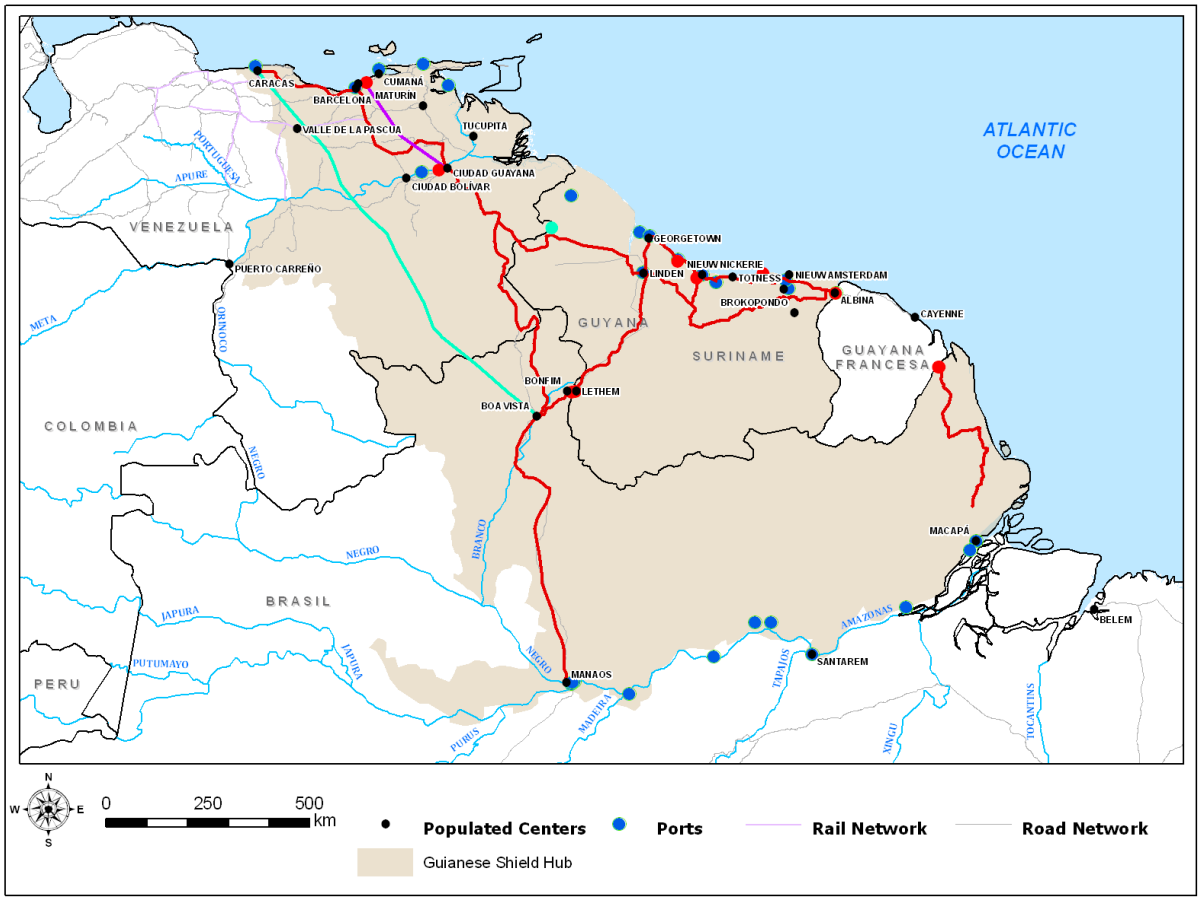
Amazonas and Pará have the most economic strength, the former contributing 69% and the latter 29% to the Hub's total GDP.

From the perspective of the countries' contribution to the economy of the Hub by administrative units and their economic activities as reflected in the Hub's GDP, Guyana and Suriname are the nations most linked to and/or dependent on the Hub, as they contribute 100% of their GDP.

With regard to the performance of the countries' major economic sectors, the importance of agriculture and mining and quarrying in Guyana and Suriname stands out, as they are net exporters of related raw materials. Venezuela shows the most balanced values, except for agriculture (5%). In Brazil, the services sector stands out, accounting for 79% of the GDP in the administrative units in the Hub.

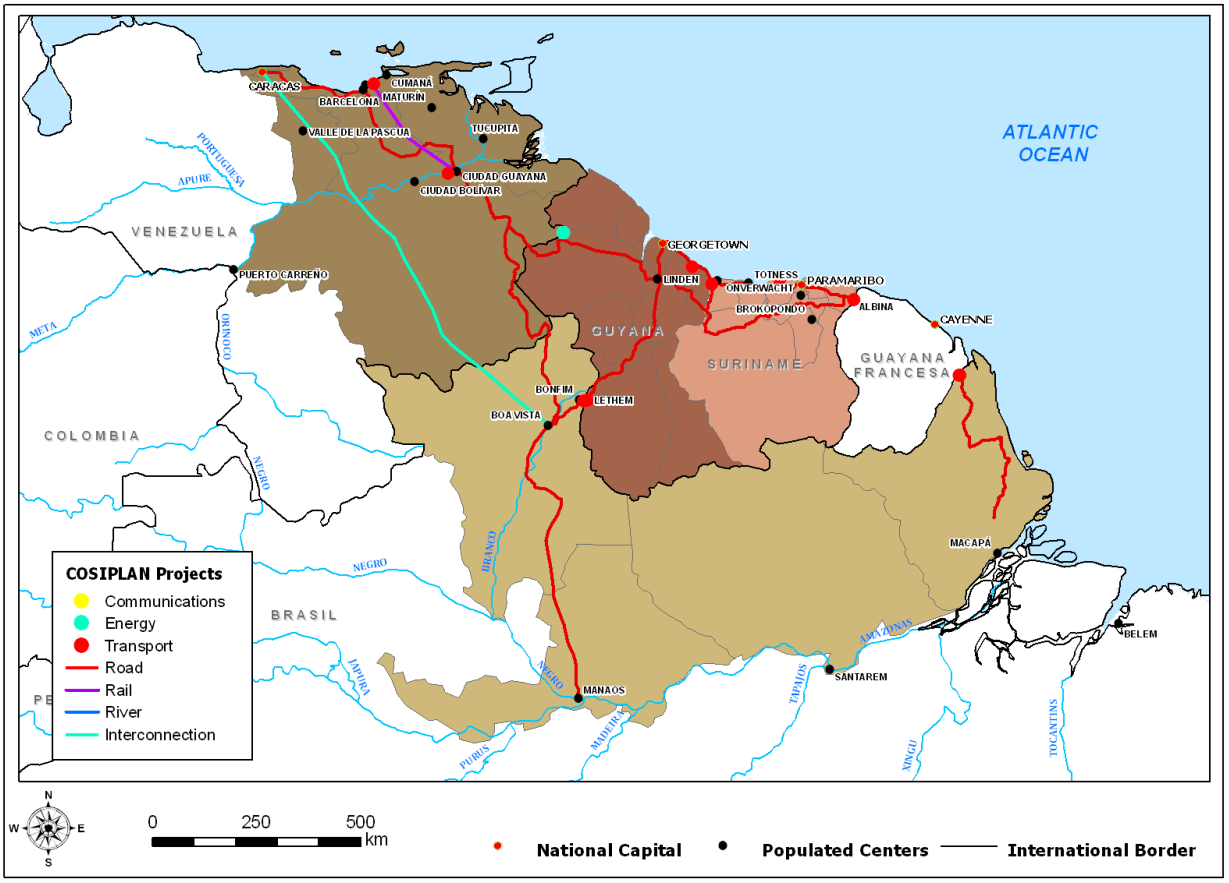
Concerning exports among the countries involved in the Hub, in general Brazil and Venezuela account for most of the trade between such countries. More specifically, Brazil is the main destination of Venezuela's exports within the Hub and vice versa, accounting for about 95% of total trade. Brazil and Suriname have positive trade balances, whereas Venezuela and Guyana have negative trade balances.

Figure 10.1: Infrastructure in the Guianese Shield Hub



Source: Prepared by the author

Figure 10.2: COSIPLAN-IIRSA Indicative Territorial Planning Project Portfolio



Source: Prepared by the author

A global look at the infrastructure projected for the countries involved in the Guianese Shield Hub on the basis of the COSIPLAN-IIRSA Indicative Territorial Planning Methodology (**Figure 10.2**) shows the challenge of contributing to the economic development of areas lagging behind through the provision of infrastructure, particularly in the administrative units of Guyana and Suriname and those of southern Venezuela.

Consequently, there is a need to implement and/or plan initiatives designed to create or strengthen the links among Venezuela, Brazil, Guyana, and Suriname by improving north-south road connections and building new ones between Venezuela, Guyana and Suriname.

From a social perspective, the HDI, calculated by the UNDP, reveals that, in general, the administrative units that are distant from the political, administrative, technological, and industrial centers as well as markedly rural and less populated, featuring a lower economic activity, have the lowest HDI values, lagging behind the context of high human development in the main centers of the Hub. The states of Pará in Brazil and of Guárico and Delta Amacuro in Venezuela are cases in point.

Hence, COSIPLAN-IIRSA face both the challenge and the opportunity of helping provide such areas, through actions within their scope and possibilities, with more connectivity, energy and

communications infrastructure in order for them to attain higher levels of education, health, and economic activity that creates trade and higher income for the local population, all of which will result in an increased human development index.

Concerning the hazards affecting the Hub (**Figures 9.1** through **9.5**), the assessment made in this report clearly shows that the administrative units located on the northern coast of Venezuela are prone to three of the major and most devastating hazards in the continent -earthquakes, floods, and landslides.

Furthermore, all the area along the banks of the vast Amazon and Orinoco Rivers and their tributaries, which involves portions of the Venezuelan, Brazilian, Guyanese, and Surinamese territories, are exposed to hydrometeorological hazards, such as floods caused by heavy rainfall and channel overflows, aggravated by the poor condition of the small towns and villages in the interior of the Hub.

As regards the hazards present in Venezuela (earthquakes, urban flooding, and landslides), their occurrence is likely to result in impassable roads and affect the most important urban and industrial areas of the country as well as the ports for hydrocarbon exports and their associated refineries.

In the case of the territory of Guyana, floods and landslides cut roads such as the one linking Linden and Georgetown, which is the only connection to the country's inland, preventing the movement of people and the provision of emergency services in the case of extreme events.

The permanent exposure to these types of hazards leads the countries involved in the Hub to face the challenge of moving forward with risk management, but this entails a joint effort towards the implementation of actions and measures aimed at establishing multilateral integrated systems to handle these threats, taking into account that they affect areas that exceed the territory of a single country, as is the case of the Amazon basin or the territory between Guyana and Venezuela.

As for threats affecting protected areas -many of which host vast expanses of natural ecosystems, tropical rainforest and moist forests holding the most biodiversity on the planet-, the analysis reveals that the likelihood of direct threats to these and other similar areas is low (**Figure 7.2**), given that most projects or improvements will be implemented keeping existing alignments and sites. However, the proximity of the works to be built, the increase in vehicular traffic, and the growth in forestry and mining promoted by connectivity infrastructure lead to greater environmental stress, and deforestation of rainforest becomes a major threat, with the resulting irreparable loss of biodiversity and subsequent displacement of indigenous people and expansion of mining with erosive and polluting practices in fragile ecosystems.

There is, therefore, the urgent need to carry out complementary studies to identify the impact of infrastructure implementation as well as of the processes and changes that this involves, so as to promptly take all the environmental protection measures necessary to counter or mitigate such impact, within the context of territorial planning and compliance with laws and international treaties in force.

This should be supported by environmental education initiatives, sustainable resource management plans, and the establishment of natural reserves wherever possible, with the

purpose of protecting natural ecosystems and the environmental services that they provide to the communities living in the territory of the Hub, such as slope stabilization, drinking water supply, soil preservation, wild food provision for indigenous communities and rural population, and the development of tourism activities, among others. The sustainable development paradigm could thus be a reality, contributing to ensure the economic and social development of the Hub's communities over time.

Concerning the presence of indigenous communities in the interior of the Hub, their interaction with the infrastructure planned within the framework of COSIPLAN-IIRSA is highly relevant (**Figure 8.1**). In this regard, one of the most important challenges is to integrate the indigenous communities into the new prospects of improved connectivity, which, among other impacts, will lead to an increase in the flows of goods and people, the expansion of forestry, or the transformation of ecosystems as a result of areas of inundation or energy transport networks. This outlook is generally resisted and is not part of the development perspective of these communities, thus representing both a challenge and an opportunity -to ensure a sustainable development model on the basis of an inclusive society that not only respects diversity but also regards it as an essential asset for their subsistence.

ACRONYMS AND ABBREVIATIONS

AU	Administrative Unit
AI	Area of Influence
BIZ	Border Integration Zone
CERESIS	Centro Regional de Sismología para América del Sur (Regional Center for Seismology for South America)
CIER	Comisión de Integración Eléctrica Regional (Regional Electric Integration Committee)
COSIPLAN	South American Infrastructure and Planning Council
DANE	Departamento Administrativo Nacional de Estadística de Colombia (National Administrative Department of Statistics, Colombia)
DIPECHO	Disaster Preparedness European Community Humanitarian Office
ECLAC	Economic Commission for Latin America and the Caribbean
ENOS	(Phenomenon) El Niño, Southern Oscillation
IBGE	Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics)
HDI	Human Development Index
IIRSA	Initiative for the Integration of Regional Infrastructure in South America
INE	Instituto Nacional de Estadísticas de Venezuela (National Institute of Statistics, Venezuela)
MERCOSUR	South American Common Market
PREDECAN	Andean Community Disaster Prevention
TEU	Twenty-foot Equivalent Unit. Cargo capacity of a standard-size, 20-foot container
UNASUR	Union of South American Nations
UNISDR	United Nations Office for Disaster Risk Reduction