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## South-South cooperation in the nexus of climate change and infrastructure development in Paraguay

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**Cover Photo:** shutterstock.com

## I. Introduction

### A. Objective

The world will exceed the temperature increase of 1.5°C by 2035 and faces a 2.5°C warming by 2100<sup>2</sup>. The negative effects of climate change will result in the increased frequency of severe weather phenomena and disasters, inundation and salination of low-lying agricultural land, droughts and disruption of people's livelihoods. These occurrences will be followed by higher human mortalities due to natural disasters and famines, especially in vulnerable countries, as well as damage and destruction to infrastructure and disruption of supply chains and economic activity. Despite the fact that the 32 landlocked developing countries (LLDC)s together are responsible for less than 1.9 per cent of the global total of greenhouse gas (GHG) emissions, these countries will be severely affected by these negative effects of climate change<sup>3</sup>. The objective of this case study, compiled as a background document to the Ministerial Meeting on South-South Cooperation at the third United Nations Conference on Landlocked Developing Countries (LLDC3) is to show how an LLDC has balanced the challenges of development with the need to address climate change.

The challenges and actions of LLDCs pertaining to climate change have been

2. United Nations, Department of Economic and Social Affairs, Sustainable Development, "Goal 13, Overview: Earth's tipping point, standing at the brink of climate calamity, where we are".

3. [https://www.un.org/sites/un2.un.org/files/a\\_conf\\_225.2024.4\\_draft\\_outcome\\_document\\_n2410570.pdf para. 217](https://www.un.org/sites/un2.un.org/files/a_conf_225.2024.4_draft_outcome_document_n2410570.pdf para. 217).

outlined in the draft Programme of Action for Landlocked Developing Countries for the Decade 2024–2034 (PoA), priority area 4: “Enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change and disasters”<sup>4</sup>. The present case study focuses on the efforts of Paraguay during the Vienna Programme of Action for Landlocked Developing Countries for the Decade 2014–2024 and the coronavirus disease (COVID-19) pandemic period (2019–2022). It is worth noting that climate change is a new addition to the Programme of Action for the LLDCs (not present in the VPoA).

Furthermore, the focus of the case study on the bioceanic corridor illustrates the Government efforts with its regional partners to develop sustainable and resilient infrastructure, as called for in Sustainable Development Goal 9 and, indeed, the other areas of the draft PoA. Paraguay maintains that development and climate change actions are not incompatible and that the challenges of landlockedness can be transformed into opportunities. This was stated by the President of Paraguay during the general debate of the 79th session of the General Assembly when he said, in reference to his country that the generation of hydroelectric energy was not only a national project but also a joint initiative with its neighbours. He further observed that the location of Paraguay in the heart of South America means that it can be an engine for integration<sup>5</sup>.

4. [https://www.un.org/sites/un2.un.org/files/a\\_conf\\_225.2024.4\\_draft\\_outcome\\_document\\_n2410570.pdf](https://www.un.org/sites/un2.un.org/files/a_conf_225.2024.4_draft_outcome_document_n2410570.pdf), para. 217.

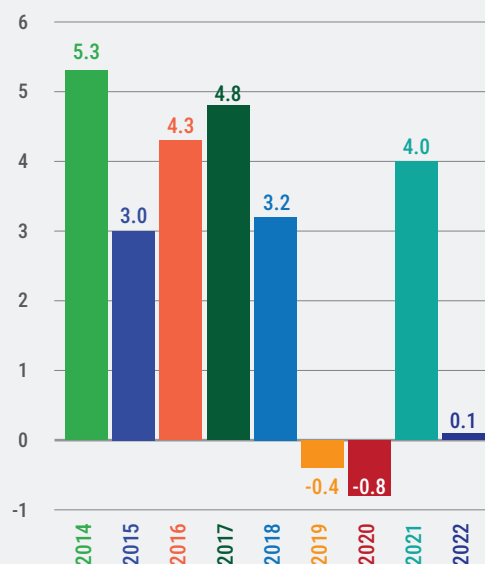
5. See <https://gadebate.un.org/en/79/paraguay>.

## II. Socioeconomic profile of the country

Paraguay is an upper-middle-income landlocked country of about 7 million people. Its gross national product (GNP) growth rate has fluctuated over the last 10 years, marked by a high of 5.8 per cent in 2014 and negative growth during the COVID-19 pandemic, bottoming out at -0.8 per cent in 2020 (figure 1)<sup>6</sup>.

The high vulnerability of Paraguay to climate change is exacerbated by its status as a landlocked country. Adaptation is seen as a priority national approach. A report by Interactive Country Fiches indicates that that “2019 was the hottest year for the country with a temperature of 1.5 °C above the average of the period 1961–1990”<sup>7</sup>.

**Figure 1. Gross domestic product growth (%), 2014–2022**



Source: The CIA, The World Factbook, “Paraguay”.

6. The Central Intelligence Agency (CIA), The World Factbook, “Paraguay”. Available at <https://www.cia.gov/the-world-factbook/countries/paraguay/> accessed 11 November 2024.

7. <https://dicf.unepgrid.ch/paraguay/climate-change>.

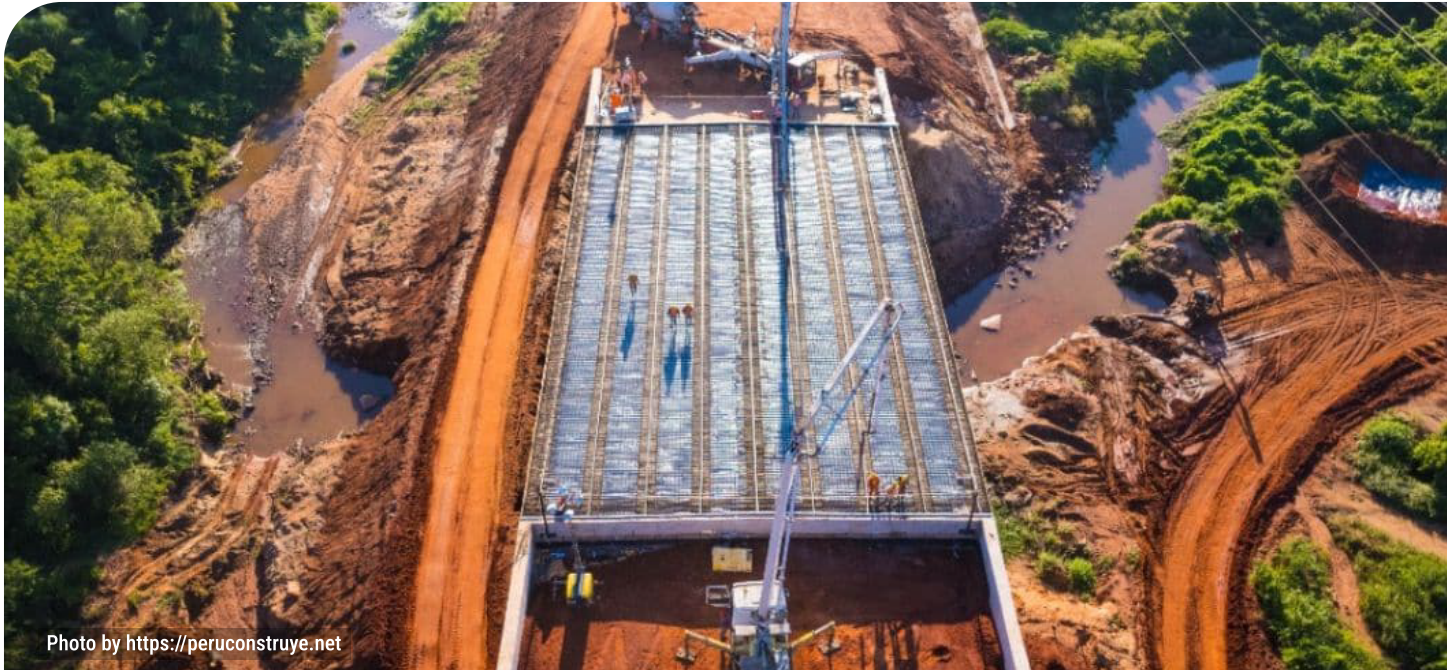


Photo by <https://peruconstruye.net>

An assessment of the impact of climate change, which would be triggered by a 0.9° to 1.9° increase in temperature by 2050 in Paraguay, shows that it would result in significant changes to the future progress of the country. Paraguay is still reliant on agriculture and livestock production. The changes in temperature will impact agriculture through extreme weather events including flooding, droughts, increased forest fires and an increase in pest populations. Furthermore, floods will lead to damage to infrastructure such as roads and hydroelectric power plants. Damage to the aquatic system due to river floods, damage to roads due to flooding, heat stress on livestock and the need for more water, and decreased hydroelectric generation due to droughts, are all concerns regarding the impact of climate change in Paraguay<sup>8</sup>. These impacts could lead to an erosion of the momentum in economic growth seen in the past few years, disruption of people's

8. United States Agency for International Development, Fact Sheet, "Climate Risk Profile: Paraguay". Available at [https://www.climatelinks.org/sites/default/files/asset/document/Paraguay\\_CRP.pdf](https://www.climatelinks.org/sites/default/files/asset/document/Paraguay_CRP.pdf).

livelihoods and higher mortalities due to natural disasters. Although most of the population of Paraguay is found in the major cities, there are rural populations, including Indigenous Peoples. Two per cent of the inhabitants of Paraguay live in the Chaco region through which the bioceanic corridor passes.<sup>9</sup>

Paraguay is a State Party of the Southern Common Market (MERCOSUR), along with Argentina, Bolivia, Brazil and Uruguay. The Bolivarian Republic of Venezuela is also a State Party of MERCOSUR, but its membership was suspended in 2016. MERCOSUR has several associate members, including Chile, Colombia, Ecuador, Guyana, Peru and Suriname. The major infrastructure projects including the bioceanic corridor are shared with MERCOSUR countries and other neighbours, showing traits of strong South-South cooperation. In January 2024, Paraguay joined Grupo SUR together with Argentina, Brazil, Ecuador and Uruguay.

9. The CIA, The World Factbook, "Paraguay".

### III. Paraguay and climate vulnerability

Across all 32 LLDCs, approximately 54 per cent of the land is classified as dryland and 60 per cent of the LLDC populations live in those areas. Measuring risk is necessary to protect the people living in drylands. Risk assessment is one of the main approaches called for in the draft PoA priority area 4.

Over the years, several frameworks have been developed to assess climate-change vulnerability. Among them are spatial analysis projections, bioclimatic models and trait-based indices of vulnerability. The assessment models are useful in leading adaptation planning. Among these indices is the Notre Dame Global Adaptation Index (ND-GAIN), which has been calculated for 177 countries over the past 17 years. The ND-GAIN of a country is composed of vulnerability and readiness scores. Vulnerability measures “a country’s exposure, sensitivity and ability to adapt to climate change”. The Index measures overall vulnerability in food, ecosystem service, health, human habitat and infrastructure. The model has been chosen to be in this study because it resonates with the sectors most impacted by climate change in general and likely to be impacted by climate change in Paraguay<sup>10</sup>.

According to the Paraguay ND-Gain matrix, the main vulnerable areas for the period 2003–2022 were transportation (paved roads), particularly improvements of roads to rural areas; a downturn in production of cereal yields (rice, wheat and maize); and the country capacity to acquire and use agricultural technology. In terms of readiness, the sector assessed as the least ready to cope with impacts of climate change was education, relating to the ability of the country to bring tertiary education to the population group that corresponds to the tertiary education attendance<sup>11</sup>. The other area identified was the ability of the country to harness innovation to meet the challenges of development and climate change.

A 2014 report by the Development Bank of Latin America and the Caribbean (CAF) entitled *Vulnerability Index to Climate Change in the Latin American and Caribbean Region*<sup>12</sup> concluded that Paraguay (8<sup>th</sup>) was one of the 10 most vulnerable countries in the region. Paraguay and the Plurinational State of Bolivia (also an LLDC) were the only South American countries among the 10 deemed most vulnerable. Paraguay, in addition to being the most-at-risk country in South America also was classified at “extreme risk” on the Climate Change Vulnerability Index (CCVI).

10. Paraguay | ND-GAIN Matrix.

11. <https://gain-new.crc.nd.edu/country/paraguay>.

12. The Vulnerability Index to climate change in Latin American and Caribbean Region, 2014. Available at <https://scioteca.caf.com/bitstream/handle/123456789/509/caf-vulnerability-index-climate-change.pdf>.

## IV. Institutional framework and steps towards climate adaptation, mitigation and resilience

In 2015, and subsequently in the updated Nationally Determined Contribution (NDC), Paraguay committed to reduce its GHG emissions by 20 per cent. In the case of adaptation, the First Adaptation Communication as reported in the updated NDC indicates that 25 objectives were established with their lines of action, gaps and needs in seven sectors. These prioritized sectors and cross-cutting elements are shown in figure 2.

To date, Paraguay has taken important steps towards climate resilience. The Ministry of Environment and Sustainable Development, together with the National Commission on Climate Change (currently composed of 37 institutions from the public and private sectors, academia and civil society), has promoted numerous public policy instruments to address adaptation.

In addition to identifying the key sectors for climate action, cross-cutting undertakings including risk management, regulatory aspects, gender vulnerability, Indigenous communities, climate empowerment and action as well as research and technology were identified. Furthermore, ensuring the means of implementation (capacity-building, climate technology and financing) and the institutional arrangements necessary to articulate efforts at the national and

subnational levels are considered key elements. The partnership with the private sector is also identified as an important requisite to achieve effective compliance with the NDC. These considerations are reflected in the national policies, strategies and frameworks listed in the next sections.

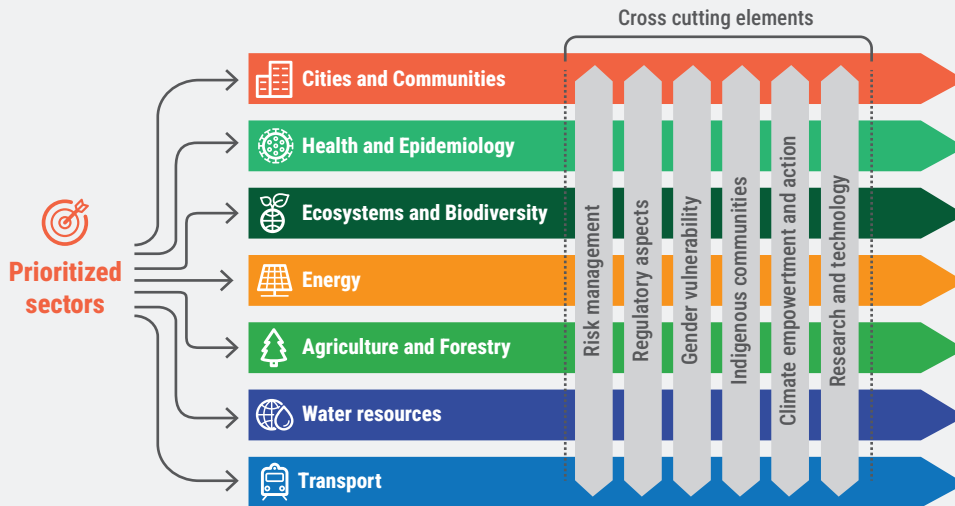
### Public policies on adaptation

The information presented in boxes 1 and 2 show that Paraguay has, for a long time, included climate change in its policies, development strategies and partnerships with other countries at the regional and global level.

Box 1 lists the national strategies, policies and plans adopted by Paraguay towards sustainable development and climate change adaptation and mitigation. In 2014, the country developed the Paraguay 2030 National Development Plan that was already focused on sustainable development. However, even before that, Paraguay had developed a National Climate Change Policy in 2011, well before the international agreement on Sustainable Development Goals in 2015. In 2015, the country finalized its first National Determined Contribution (NDC).

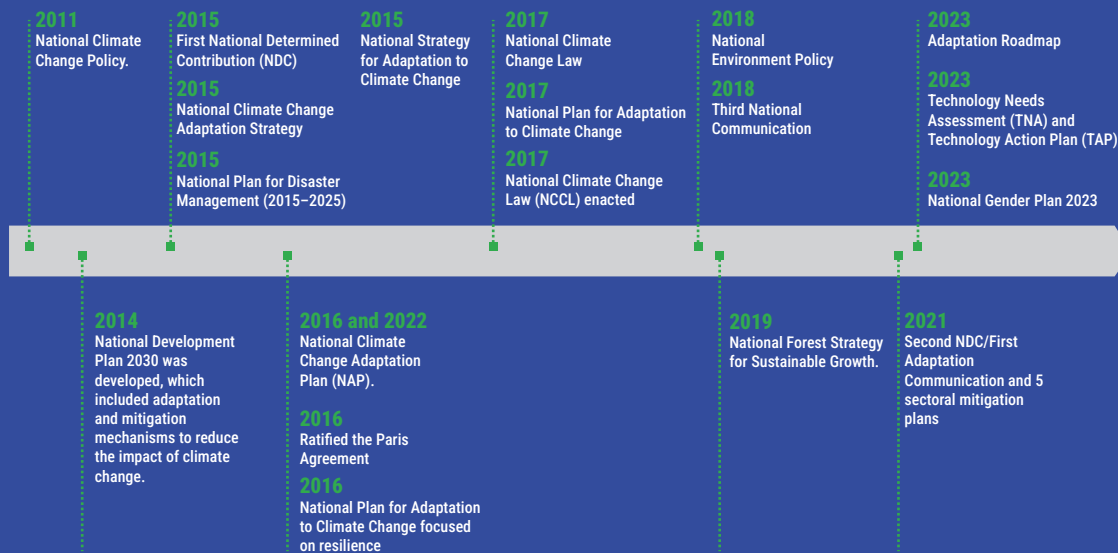
The international agreements and commitments entered into by the Government of Paraguay are listed in Box 2. By and large, the country has been involved in all major climate change agreements and treaties, demonstrating its commitment. The examples of collaboration with its neighbours are described in the following sections.

Figure 2. Prioritized sectors and cross-cutting themes



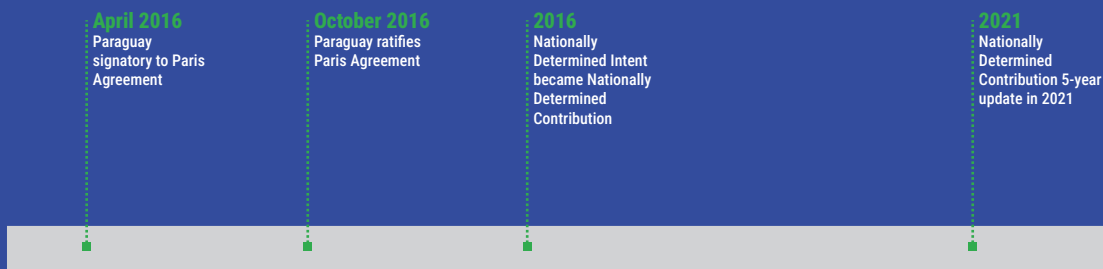
Source: MADES/PNUD, 2022. Plan Nacional de Adaptación al Cambio Climático de Paraguay 2022-2030 (Asunción, Paraguay, p. 120).

Box 1. National strategies, policies and plans on climate change



Source: NDC Update 2021. Available at <http://dncc.mades.gov.py/ndcs-de-la-republica-del-paraguay>.

## Box 2. International agreements on climate change signed by Paraguay



Source: See "Paraguay" | UNFCCC.

In general, Paraguay is a country engaged in South-South cooperation. For example, it is one of six countries (that also include Argentina, Cuba, Guatemala, the Dominican Republic and Uruguay) that signed a project agreement on Enhancing Climate Finance and Investment in Latin America and Caribbean (LAC) Banking Sector in collaboration with the Latin American Association of Development Financing Institutions (ALIDE). The objective of the project is to coordinate individual bank efforts under a regional umbrella and to increase the number of Green Climate Fund entities and projects in line with climate policies and frameworks. The actual work will constitute environmental and climate change financing and knowledge exchanges on climate financing.

The Paraguay partnership with Brazil in building the Itaipu Dam on the Parana River is an example of effective South-South cooperation. Commissioned in May 1984, the United Nations Framework Convention on Climate Change noted that the dam generates

the most hydroelectricity in the world. It was also built to combine climate and sustainable action entailing enhancing economic development, income and jobs creation and at the same time avoiding negative climate change and environmental impacts. A 17 November 2017 story by United Nations Climate Change indicated that the dam contributes 78 per cent to the Paraguay energy network. Furthermore, explaining its impact in adaptation, it was noted that "in order to generate the same energy, it would take 5 billion barrels of oil, equivalent to 51 days of oil production (based on 2016 data). This would lead to 1.2 billion tons of CO<sub>2</sub> equivalent."<sup>13</sup>

Another example of collaboration is the agreement signed by Paraguay and neighbours Argentina, the Plurinational State of Bolivia, Brazil and Uruguay on the Paraguay-Paraná waterway. The two rivers provide 3,442 km of

13. United Nations, United Nations Framework Convention on Climate Change, United Nations Climate Change, "Brazil and Paraguay's Itaipu Dam works to combine climate and sustainability action", 17 November 2017.

waterway to the Atlantic for all the signatory countries. The waterway allows transport of goods, especially traded goods from the interior of the continent. As Paraguay is situated at the confluence of the two rivers, it is a critical partner for transportation despite its landlocked status. There is more that needs to be done to help to strengthen the role of Paraguay in transporting goods from the centre of the continent. This includes improving the navigability conditions of the Paraguay-Parana system to achieve optimal utilization 24 hours a day, 365 days a year, adopting and resizing the fleet, and enhancing the infrastructure of the ports. Located there in accordance with current commercial exchange requirements in the area of influence. An article by the United States International Trade Administration notes that the waterway is a conduit for nearly 80 per cent of the traded goods of Paraguay.<sup>14</sup>

MERCOSUR countries have acted together to address climate change threats. An important example of these joint efforts is the formation of the “Grupo SUR”. On 22 February 2024, the Government of the Argentine Republic, in its capacity as coordinator of the Argentina, Brazil, Uruguay (ABU) negotiating group, informed the secretariat of the United Nations Framework Convention on Climate Change that Paraguay had joined the group, which from that moment onwards became known as the “Grupo SUR”. Ecuador later joined the grouping.

Even with these examples of collaboration on climate change and development with its neighbours, the main challenge in responding to the climate change in Paraguay is seen as a need to have a holistic approach, to consolidate institutional, intersectoral and subnational arrangements for planning, implementing and monitoring actions aimed at reducing vulnerability and increasing resilience. This also includes integrating and adjusting national policies as well as legislative and regulatory frameworks.

## V. Climate change, Sustainable Development Goals and the Draft PoA for LLDCs

Climate change impacts all the pillars of development, i.e. social, economic and environmental. Sustainable Development Goal 13 was crafted with this underlying foundation that climate change will impact all three pillars and that whatever action – economic, social or environmental – is undertaken will also have an impact on climate change. The target areas for selected Goals reflect that relationship between climate change and economic and environmental sectors. They are presented in table 1.

14. United States of America, International Trade Administration, “Paraguay-Parana waterway system”, 5 March 2024.

**Table 1. Sustainable Development Goal 13 targets and Programme of Action priority area 4 intended actions and targets**

SDG 13 recommended actions	PoA proposed actions
Strengthen resilience and adaptive capacity to climate-related disasters.	<ul style="list-style-type: none"> <li>• Use frontier technologies for mitigation and adaptation.</li> </ul>
Integrate climate change measures into policies and planning.	<ul style="list-style-type: none"> <li>• Encourage partnerships for understanding disaster risk, disaster risk education, comprehensive risk management, building academic and scientific capacity.</li> </ul>
Build knowledge and capacity to meet climate change.	<ul style="list-style-type: none"> <li>• Support traditional, Indigenous and local knowledge practices.</li> </ul>
Implement the United Nations Framework Convention on Climate Change (UNFCC).	<ul style="list-style-type: none"> <li>• Adhere to principles of the Rio Declaration on Environment and Development, including the principle of “common but differentiated responsibilities”.</li> <li>• Increase climate change finance to support adaptation, including contributions to the Adaptation Fund and the Green Climate Fund.</li> <li>• Follow Glasgow Climate Pact urging developed countries to double their climate finance for adaptation.</li> <li>• LLDCs intend to develop a work programme for LLDCs under the UNFCC.</li> <li>• Countries continue to submit progress on national determined contributions.</li> <li>• Address, through technology transfer and capacity-building, poverty reduction and other areas impacted by climate change.</li> </ul>
Promote mechanisms to increase capacity for planning and management.	<ul style="list-style-type: none"> <li>• Disaster risk education</li> </ul>

**Source:** United Nations, Department of Economic and Social Affairs, “Sustainable development, [Goal 13](https://sdgs.un.org/goals/goal13)”. Available at <https://sdgs.un.org/goals/goal13>.

Figure 3. Bioceanic corridor



Source: See the bioceanic corridor image - Search Images.

## VI. Bioceanic corridor

The bioceanic corridor illustrates that, despite other challenges, landlocked countries in the Global South are directing resources towards climate adaptation and mitigation. Furthermore, it shows that South-South cooperation can enhance that focus on climate change in building resilient infrastructure.

The bioceanic corridor is considered the Panama Canal of the 21<sup>st</sup> century. Current estimates by the Government are that it will cost approximately \$6 billion when completed. About 2,400 km of paved road will link the Atlantic coast of Brazil to the Pacific coast of Chile through Paraguay and Argentina (figure 3). Approximately five hundred kilometres of the road will be in landlocked Paraguay, about 50 per cent of which have already been paved and is in use.

In Paraguay, the bioceanic corridor runs through the vast Chaco Region and from its border towns of Captain Carmelo Peralta (border with Brazil) and Pozo Hondo (border with Argentina). The corridor therefore passes through the hot and arid grasslands of the Chaco Region. Although sparsely populated (2 per cent of the population of Paraguay),<sup>15</sup> the Chaco Region is characterized by summer temperatures that can exceed 40° C and droughts that alternate with floods during the rainy season. It also has limited infrastructure for essential services, making the local populations very vulnerable to climate change. The national institutions are challenged to meet the needs of the sparsely distributed population in the Chaco Region.<sup>16</sup>

15. <https://www.cia.gov/the-world-factbook/countries/paraguay/>

16. United Nations, Sustainable Development Group, "Beyond borders: Leaving no one behind in the Gran Chaco Region", 2 December 2021.

The bioceanic corridor was formalized by Argentina, Brazil, Chile and Paraguay in 2015 to stimulate development in the then-less-developed parts of western Brazil, northwestern Argentina, northern Chile and the central Chaco Region in Paraguay. A working group representing the four countries worked on the ideas to promote both interregional (especially given the growing markets in Asia) and intraregional trade.

The benefits to Paraguay from the completion of the bioceanic corridor will be an immense accelerator for economic development through access to the Chaco Region rich in mineral and agricultural resources. The corridor will require infrastructure such as hotels, gas stations and new roads and railways to access it and the creation of jobs. The new infrastructure will require sustainable energy supplies. However, there are possible social and environmental risks.

Since 50 per cent of the Paraguay section of the road through the corridor has been completed, lessons derived from this experience can be applied to design a corridor that will meet the potential (in benefits) for the people of Paraguay and mitigate impacts of climate change on the infrastructure, people and biodiversity in its area of reach.

#### **A. How has climate change been mitigated in the completed parts of the corridor?**

The Directorate of Socio-Environmental Management (DGSA) reports to the Office of the Minister of Public Works and Communications (MOPC) and is designated as the coordinating body for the social and

environmental components of all infrastructure and service projects developed by the Offices of the Vice-Ministers, directorates or project executing/coordinating units. The DGSA is responsible for incorporating the environmental and social components in all stages of MOPC project cycle, including the incorporation of climate change adaptation actions in its full scope to the work planned and executed by the MOPC.

All high-impact projects such as the bioceanic corridor must comply with Law No. 3001/06 on “Valuation and Remuneration of Environmental Services”,<sup>17</sup> the objective of which is to promote the conservation, protection, recovery and sustainable development of the biological diversity and natural resources of the country. This law establishes that all high-impact projects must invest an amount that is no less than 1 per cent of total cost towards the acquisition of certificates of environmental services. Furthermore, Article 42 of Law No. 422/73 establishes that all rural properties over 20 hectares in forested areas must maintain twenty-five per cent of their area as natural forests. Table 2 summarizes the progress and actions carried out to manage risks and adaptation to climate change through good practices and proper environmental management within the framework of the construction of the bioceanic corridor.

17. [https://climate-laws.org/document/law-n-deg-3001-06-strengthening-the-adaptation-capacity-of-eco-systems-and-the-protection-of-their-biodiversity\\_9b99](https://climate-laws.org/document/law-n-deg-3001-06-strengthening-the-adaptation-capacity-of-eco-systems-and-the-protection-of-their-biodiversity_9b99)

**Table 2. Climate change adaptation and mitigation in the bioceanic corridor**

Project/ Initiative	Scope	Implementation
Carmelo Peralta Bridge	In addition to strengthening regional integration, will provide access to the bioceanic road corridor.	Its construction will directly benefit 19,000 Paraguayans and will contribute to the socioeconomic growth of the entire Paraguayan Chaco, in addition to improving international connectivity, reducing transportation costs and, therefore, reducing the use of fossil fuels by presenting a transportation alternative other than the river.
Water resources monitoring	Water resources monitoring in the area affected by the bioceanic corridor has already been completed.	Within the framework of the implementation of the Environmental Management Plan, reports were prepared on the rainfall patterns in the bioceanic corridor area as well as recording the effect(s) of excess and deficit of precipitation. The collected information can be utilized for climate change adaptation studies in the zone. In addition to monitoring, measures were taken to minimize the effects of the project on the scarce water resources.
Direct impact mitigation programme	Bioceanic corridor	The implementation of the bioceanic corridor infrastructure road work required compliance with the <b>General Environmental Technical Specifications (ETAG)</b> . The correct implementation of the requirements of this document, legal obligations and institutional regulations require that the actions taken in the construction of the corridor should not have a significant impact on the environment, should reduce the emission of greenhouse gases and pollution, promote good environmental practices, and encourage people to implement adaptation measures for climate change.

Project/ Initiative	Scope	Implementation
Indirect impact mitigation programmes	Bioceanic corridor	<p>This set of programmes and actions minimized the effects of environmental impacts that were not a direct result of the bioceanic corridor work. Through the <b>institutional strengthening programme of the municipalities</b>, the capacities of the technicians and decision makers of the municipalities in environmental management were strengthened in the area of influence of the bioceanic corridor.</p> <p>Furthermore, through <b>environmental education programmes for the community</b>, tools for sustainable agricultural production techniques were provided, covering issues of soil and water management and conservation, and ecological gardens, among other topics. The education targeted the need to change production and farming systems behaviour in order to take environmentally sustainable measures that are framed within the requirements of adaptation to climate change.</p>
Environmental control and monitoring Plan	Bioceanic corridor	<p><b>The monitoring of land use and occupation</b> and the <b>monitoring of fauna and flora</b> enabled effective observation of environmental degradation actions, especially deforestation actions, the advancement of settlements over critical areas in terms of environmental fragility, and the impact on the genetic pool of native species in the area of influence of the bioceanic corridor. Environmental monitoring measures are closely linked to environmental surveillance that is required to establish prevention and mitigation processes that are set in laws and in national and international policies for adaptation actions required for climate change.</p> <p>Fauna crossings are incorporated into the infrastructure to reduce the levels of fauna being run over by vehicles along the bioceanic corridor. The crossings protect local fauna while contributing to road safety.</p>
Changes of native land to other uses	Bioceanic corridor	<p>At this stage of the Bioceanic Corridor Project, the “Protocol for joint intervention upon detection and verification of land use changes in native forest within the framework of Law No. 6676/2020 and other legal provisions” was implemented in coordination with the National Forestry Institute (INFONA). The law is linked to land use changes from native forest to other uses.</p>

Source: Directorate of Socio-Environmental Management (DGSA), conveyed 5 July 2024.

## B. Future planning in light of the expansion of activities in the bioceanic corridor

Climate change financing and transfer of appropriate technologies, identified in the past as important contributions of the international community, stand out as unresolved in the case of the bioceanic corridor.

In addition to steps already taken in enhancing adaptation, due consideration needs to be given to making the road network more resilient and less vulnerable to flooding, high temperatures and changes in weather phenomena. The World Bank indicated that there is evidence of more frequent extreme weather events such as intense rainfall, heatwaves and an increase in rainfall amounts in November and December associated with floods. Furthermore, the Government has indicated in the input to this case study that the floods occur suddenly after summer storms. Normal rainfall in the bioceanic corridor area is 600 mm per year. Intense rain falling in short bursts causes damage to the asphalt. The area of the bioceanic corridor that has low rainfall, very high temperatures (above 42° C in the summer) and the highest wind intensity in the north of the country is particularly vulnerable.

Assessments to minimize exposure to these natural hazards, the need for additional structural or non-structural measures to be put in place, and estimates of the costs of implementing environmental prevention and mitigation measures in the economic feasibility analysis of the design could be undertaken at all stages of the road network and of the project cycle. Vulnerability to

natural disasters is to be taken into account pertaining to natural causes as well as anthropogenic phenomena.

In flash-flood zones along the bioceanic corridor, actions are needed to avoid levee effects.<sup>18</sup> This can be achieved by raising the embankments on the roads. For road design, consideration needs to be given to climate resilience to withstand changing conditions such as increased temperature or flooding.

Some options for managing climate change risks include consideration of further budgetary allocations, subject to the availability of funds for the following:

- installing culverts to direct flooding away from roads;
- raising roads or bridges above the historical flood levels of water bodies;
- improving infiltration systems using porous pavements or bioretention ponds;
- avoiding pavement damage due to extreme temperatures that causes deformation or softening of the asphalt, and, in required locations, using hydraulic concrete pavement; and
- implementing the Blue Spot analysis (BSA) methodology, a risk management tool that not only takes into consideration the effects of climate change but also estimates damage and losses caused by hydrometeorological events.

18. Increase in risk of flooding due to prevention of water returning to the river by levees and disconnection of a river from its floodplain leading to reduced groundwater recharge.

Relating to the above, the DGSA is awaiting the final design work to update the Environmental Impact Study and propose programmes that will contain environmental mitigation measures.

The completed work in the bioceanic corridor shows the Government endeavour to address both direct and indirect impacts of climate change. However, at the same time, it is clear that necessary actions have not been carried out owing to resource constraints. Thus, the calls in the draft PoA for increased financing to enable LLDCs to pursue economic development while addressing the impacts of climate change are significant.

## VII. South-South cooperation and inclusive approaches

Examples of South-South cooperation activities by Paraguay have been described in earlier sections. South-South cooperation, particularly among neighbours, is essential for a landlocked country such as Paraguay. The general principles at the centre of South-South cooperation, including mutual respect and sovereignty, have been attributed to fostering peace among neighbours, a requisite for cooperation. Furthermore, the idea of solidarity, sharing both costs and benefits, is also an essential requisite for an LLDC to prosper.

While such large infrastructure projects provide opportunities, they may also have unintended negative impacts. Climate impacts in the bioceanic corridor region are unlikely to remain isolated to Paraguay. If the neighbouring countries work together, sharing costs, knowledge and resources, they are likely to be more effective in mitigating the negative impacts across borders.

Furthermore, some of the major river systems, when affected by climate change and consequent drought spells resulting in low water levels, may affect the capacity to generate hydropower as well as requiring adaptations by downstream populations in terms of food production. Lessons learned in river systems such as the Mekong Basin in Asia can be usefully shared with Paraguay.

Climate change may lead to more frequent droughts in Paraguay. There are parts of Africa and other parts of the world where farmers have lived with droughts for many years. Sharing know-how with other countries can lead to changed farming practices, to crops genetically modified to be drought tolerant and disease-resistant, and livestock that are better adapted to the changing conditions.

People-to-people exchanges through South-South cooperation would also be encouraged to assist communities whose livelihood opportunities may be changing and, in particular, to enhance innovation to adjust to the new environments.

United Nations agencies, including the United Nations Development Programme (UNDP), have assisted many countries, including in Latin America and Caribbean, to use digital technology and connectivity to address climate goals including through data to enable action, finding new financing mechanisms for climate change, and identifying and promoting digital technologies and innovation systems that lead to inclusive and sustainable solutions. Exchanges with these countries can be mutually beneficial to all partners.



Photo by <https://www.construccionlatinoamericana.com>

## Conclusions

LLDCs must sometimes pursue development opportunities even as they face potential development reversals imposed by climate change. As the present case study on Paraguay demonstrates, South-South cooperation is indispensable for collectively addressing climate change challenges and facilitating the solidarity and resource-sharing required for enduring solutions.

A major solution to challenges emanating from the status of Paraguay as an LLDC is the proposed bioceanic corridor. The scope of work done in the completed parts of the corridor in Paraguay indicate that significant resources are required for infrastructure and climate mitigation and adaptation along the corridor. There is a

need for financial resources both for the implementation of climate-resilient infrastructure works and for the generation of knowledge on the subject.

The construction of the bioceanic corridor is precisely one of the strategic actions defined for one of the adaptation objectives established for the transportation sector.<sup>19</sup> In this regard, among the gaps and needs identified for this general objective are the following: promoting the preparation of vulnerability and risk studies on climate change for the different modes of transport used in

19. Objective 25 of the National Adaptation Plan 2022–2030: To channel the development of the different transportation infrastructures to increase the resilience of the sector to the adverse effects of climate change, facilitating the mobilization of people and national and international trade.

different geographical areas, and promoting projects to strengthen the adaptive capacity of roads in flood-prone rural areas.

Ensuring the means of implementation (capacity-building, climate technology and financing) in addition to the institutional arrangements needed to articulate efforts at the national and subnational levels with the support of the private sector is key to effective compliance with the NDC in Paraguay.

There is therefore a need for support in terms of training, technical and financial assistance to implement the National Climate Change Policy, the Nationally Determined Contribution and Adaptation Communication, the National Adaptation Plan and Mitigation Plans.<sup>20</sup>

Taking into account the importance of mainstreaming the climate change approach in policies, planning and projects in the infrastructure and transportation sectors, the main needs include the generation of data and information for projections and planning. In order to develop these and other adaptation measures, it is necessary to know the risks of each specific area, with the support of vulnerability studies, and risks of the infrastructure and transportation sectors.

It is essential to consider institutional strengthening, so that the responsible authorities promote best practices on climate change action.

There is a need for strengthening and/or improvement of existing planning and policy instruments for the infrastructure and transportation sectors, utilizing multidisciplinary and participatory approaches.

The impact of South-South cooperation is felt most when countries that ordinarily would not be able to achieve their objectives alone work together to attain common objectives. The bioceanic corridor is a South-South cooperation initiative between Paraguay and its neighbours that enables Paraguay to open its interior to development and link the country to trade outlets. The focus on climate change adaptation and mitigation as well as cooperation arrangements illustrates that such projects no longer require just investment capital in infrastructure but climate foolproofing and other possible socioeconomic and environmental impacts to reduce vulnerability to the negative impacts of climate change.

20. The National Climate Change Policy has among its strategic pillars capacity-building; education, communication and public awareness; and knowledge and technology management.

## Annex. Socioeconomic profile of Paraguay, covering the period of the Vienna Programme of Action (2014–2024) and COVID-19 (2020–2022)

**Table 3. Data on socioeconomic, energy and climate vulnerability**

Country/Subregion										
Socioeconomic and environmental trends	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
GDP growth rate <sup>21</sup>	5.3	3	4.3	4.8	3.2	-0.4	-0.8	4.0	0.1	4.7
Contribution of agriculture, forestry and fisheries sectors to GDP (%) -Paraguay	11.8	9.4	10.7	10.2	10	9.7	10.7	11.3	11	
Contribution of agriculture, forestry and fisheries sectors to GDP (%) (Latin America and Caribbean)	4.7	5.4	5.9	5.6	5.4	5.4	6.5	6.7	6.5	
Infrastructure and connectivity										
% of the population with access to electricity	99	99.3	98.4	9.30	9.60	99.7	100			
% of hydropower in electricity generation from renewables	99.73	99.73	99.73	99.76	99.78	99.74	99.72	99.68		
World % of electricity production from coal	40.61	38.83	37.98	37.98	37.98	36.69	35.33	36.05	35.63	
World % of electricity production from gas	21.61	22.74	23.27	23.09	23.14	23.51	23.45	22.85	22.48	
World % of electricity production from hydro	16.43	16.3	16.39	16.09	15.97	15.9	16.41	15.16	14.96	
World % of electricity production from nuclear	10.52	10.54	10.42	10.2	10.02	10.28	9.97	9.82	9.18	
World % of electricity production from wind	4.78	4.52	4.38	4.52	4.84	5.35	6.01	6.60	7.32	
World % of electricity production from solar	3.04	3.49	3.93	3.99	3.47	3.14	3.2	3.74	4.57	

21. The CIA. The World Factbook. Available at <https://www.cia.gov/the-world-factbook/>.

Country/Subregion										
World % of electricity production from oil	1.84	1.98	1.95	2.02	2.19	2.65	3.00	3.10	3.15	
World % of electricity production from bioenergy	0.84	1.08	1.34	1.77	2.06	2.14	2.27	2.35	2.36	
World % of electricity production from other	0.33	0.34	0.34	0.34	0.34	0.34	0.35	0.33	0.34	
<b>Social</b>										
Literacy rate										94.5
Life expectancy <sup>22</sup>	72.9	73.2	73.5	71.9	73.6	73.6	72.6	70.3		78.6
Human Development Index ranking	0.716	0.723	0.721	0.715	0.727	0.732	0.743	0.717		
World average HDI	0.720	0.724	0.729	0.733	0.736	0.739	0.735	0.740		
<b>Climate change</b>										
Share of global GHG emissions								0.20%		
Emissions reduction target by 2030								20%		
Climate Vulnerability Index ranking (ND-GAIN) <sup>23</sup>	93	93	92	92	93	90	93			

Source: The CIA, The World Fact Book, "Paraguay". Available at <https://www.cia.gov/the-world-factbook/countries/paraguay/>.

22. UNDP, *Human Development Report 2023/2024*. Available at <https://hdr.undp.org/system/files/documents/global-report-document/hdr2023-24reporten.pdf>.

23. Sectors contributing to the ND-GAIN matrix are food, water, health, ecosystem service, human habitat and infrastructure.



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