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Sustainable Development

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The Sustainable Development Goals in America: Overview

Los Objetivos de Desarrollo Sostenible en América: Panorama

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Abstract

The Sustainable Development Goals (SDG), commit 193 countries to improving environmental, social and economic indicators through their performance on 169 targets by 2030 in order to achieve compliance with the Paris Agreement. However, development dynamics in relation to the SDGs change over time and with this, countries do not identify the strengths and weaknesses in which the reality of their territory is visible, in addition to the indicators they have been addressed individually because its multidimensionality generates divergent results. In this sense, the objective of this review is to analyze the state of evolution of the SDGs in America and particularly in Colombia. To analyze the SDG dynamics in 32 countries of America, we systematize the official indicator data from 2010 to 2019 and United Nations Statistics Division (UNSD) indicators, taking into account variables such as per capita gross domestic product, greenhouse gas emissions and renewable energies. As expected, the countries presented different strength in the development of the indicators related to synergies and antagonisms of the SDGs. Also, it was possible to find a wide distribution in the advancement of SDGs, finding nine countries that managed to meet at least one of the goals, which allows make visible that each of the nations has taken government initiatives to achieve development and quality of life its inhabitants.

Keywords: Quality of life, Sustainable development, Environmental Indicators.

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Resumen

Los Objetivos de Desarrollo Sostenible (ODS) comprometen a 193 países en el mejoramiento de indicadores ambientales, sociales y económicas a través de su desempeño en 169 metas para el 2030, con el fin de lograr el cumplimiento del acuerdo de Paris. Sin embargo, las dinámicas de desarrollo en relación con los ODS cambian a través del tiempo y con ello, los países no identifican las fortalezas y debilidades en las que se visibiliza la realidad de su territorio. Además, los indicadores se han abordado de manera individual debido a que su multidimensionalidad generan resultados divergentes. En este sentido, el objetivo de esta revisión es analizar el estado de evolución de los ODS en América y particularmente en Colombia. Para analizar la dinámica de los ODS en 32 países de América sistematizamos los datos de los indicadores oficiales de 2010 a 2019 y los indicadores de la División de Estadística de las Naciones Unidas (DENU), teniendo en cuenta variables como el Producto Interno Bruto PIB per cápita, las emisiones de gases de efecto invernadero y las energías renovables. Como se esperaba, los países presentaron diferentes fortalezas en el desarrollo de los indicadores relacionados con sinergias y antagonismos de los ODS. En este sentido, hubo una amplia distribución en el avance de los ODS, encontrando a nueve países que lograron cumplir por lo menos en un objetivo la totalidad de las metas, lo que permite visibilizar que cada una de las naciones ha tomado iniciativas gubernamentales para lograr el desarrollo y la calidad de vida de sus pobladores.

Palabras clave: Calidad de vida, Desarrollo sustentable, Indicadores Ambientales.

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1 Introduction

Historically, sustainable development as a concept, derives from economics as a discipline. In this sense, at the beginning of the 19th century the main discussion that gave its origin was whether the limited capacity of the earth's natural resources could support the accelerated population growth of humanity, while statistics predicted that the world's human population would continue to increase exponentially and, therefore, natural resources would not be able to meet the needs of the growing population (Mensah, 2019). However, the importance of this application was ignored for years and it was thought that it would create technology that would address this situation. For this reason, in 1972 a concept of sustainable development was first developed in UN Conference on the Human Environment held in Stockholm (Seyfang, 2003). Subsequently, in 1987 in the World Commission on Environment and Development in Norway a clearer concept of sustainable development was consolidated during the construction of the Brundtland commission report that gave rise to United Nations Conference on Environment and Development (UNCED), known as the Rio Earth Summit, in 1992. In World Summit on Sustainable Development (WSSD), known as Rio + 10, was held in Johannesburg, committed the nations to strengthen the advancement of the Millennium Goals and finally in 2012 the United Nations Conference on Sustainable Development (UNCSD) or Rio + 20 was held, which was based on the strengthening of the green economy and the institutional framework of the new SDGs (Allen et al., 2019).

The sustainable development approach is strengthened and made operational globally with the Millennium Development Goals (WHO), after which it has grown on theoretical foundations and local experiences, enhancing it as a fundamental guide to global change (Grigss et al., 2013; Kumar et al., 2016). In this regard, the 2030 agenda, which incorporates a new set of global goals known as the 17 Sustainable Development Goals (SDGs), includes economic, social, political and environmental indicators for the local and regional governments of the 193 countries of the United Nations (Kaltenborn et al., 2019), contrary to previous development agendas, based on economic growth (Kroll et al., 2019).

The implementation and evaluation of 169 goals framed within the 17 Sustainable Development Goals (SDGs) has served to determine their effectiveness at global level (Pradhan et al., 2017), through the open access database of the United Nations Statistics Division, where the SDG indicators were established since 2010 for all countries. With this reference, interest has been aroused in its study, at economic lines such as agriculture (Nasr-Allah et al., 2020), industry (Sangwan and Bhatia, 2020), education (Cebrián et al., 2020), health (Bennett et al., 2020), market (van der Waal and Thijssens, 2020), design (Horne et al., 2020) and technology (Vinuesa et al., 2020), as well as, climate change related in a transversal way (Kaltenborn et al., 2019) to carry out exhaustive analysis on the synergy quantification and interaction within and between the SDGs, as reported by Fuso Nerini et al. (2018) and Nilsson et al. (2018).

In this regard, Nilsson et al. (2016) presented one of the first quantitative methodologies of the SDGs, taking into account that the valuation is specific to each nation and its contexts; therefore, it cannot be generalized. In the same way, Moyer and Bohl (2019), highlight the importance of setting goals to achieve the objectives in favor of new generations' life, for which they propose three political paths that would enable the enforcement of SDGs: technology, lifestyle change, and decentralized governance. Thus, each country must follow a route to generate synergies within and between the goals, or compensate one goal for another, as studied for the countries that make up the G20 and the OECD, through close relationships and antagonisms (Schmidt-Traub et al., 2017).

In most nations, the issue of eradicating poverty was taken as one of the first tasks from the very MDGs, and continues to be one of the main challenges faced by humanity (SDG 1), due to its high synergy with others. Similarly, regarding responsible consumption and production (SDG 12), it has been associated with economic growth (Lusseau and Mancini, 2019). Latin American diversity is also expressed in Colombia, where there are different development levels in all aspects, due to the influence from major cities, the strong regional agricultural aptitude, or the existence of vast natural reserves, as reported by CEPAL (2017), when asses-

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sing the provinces through regional competitiveness, according to economic strength, infrastructure and logistics, social welfare and human capital, science, technology and innovation, as well as institutions and public management.

These studies have stuck together an instantaneous and extensive view on the interactions and challenges that humanity must face, which requires the maximum capacity to analyze, enforce and provide feedback through time tracking, making it possible to project the contributions for the 2030 agenda. Therefore, this research seeks to analyze the development stage of the Sustainable Development Goals (SDG) in 32 countries of America, and more specifically in Colombia, through a systematic of bibliometric information, taking into account the near past in order to evaluate its compliance/breakthroughs.

2 Methods

The research is developed through descriptive research, using the systematic research method that according to Aguilera (2014), uses electronic resources such as databases mainly, allowing a more critical view. The SDG of 32 countries of America Index and Dashboards Database (www.sdgindex.org) was used, which provides information at a global level on the Sustainable Development Goals SDGs from 2010 to 2019 and the data available from the United Nations Statistics Division (UNSD; www.unstats.un.org) in which indicators of gender, urban and rural population and groups are addressed. What is more, an exploratory analysis of variables such as per capita gross domestic product (data www.worldbank.org), greenhouse gas emissions and renewable energies (data www.iea.org) was carried out, following the methodology proposed by Schmidt-Traub et al. (2017).

The data from the 2030 agenda of the SDGs for Colombia (www.ods.gov.co) were analyzed in prospective and current terms, making correlations (Pearson) as a threshold to define the synergy and antagonism between a pair of goals, understood as synergy when the result is positive and antagonism when it is negative. However, synergy was taken into account when it was greater than 0.5 and antagonism less than $-0{,}5$, following the methodology proposed by Pradhan et al. (2017). Finally, an analysis of the national research centers and the scholars who have made the greatest academic-scientific contributions to the SDGs in Colombia was carried out.

In addition to that, an analysis of researchers and research groups in Colombia was carried out to demonstrate processes in which higher education institutions and research centers conduct the implementation and formulation of SDGs in the academic and productive areas using the platform https://sba.minciencias.gov.co/Buscador_HojasDeVida/ of the Ministry of Science, Technology and Innovation of Colombia (Minciencias). The statistical program Rstudio version 4.0.0. was used to perform the analysis, using *ggplot2*, *corrplot* and *agricolae* packages.

3 Results and Discussion

3.1 Overview of SDGs in America

America has featured different levels of progress in Sustainable Development Goals, which can be observed in Figure 1, and some countries set out a better perspective in their fulfillment of goals. Thus, the goals that have been achieved in the shortest time in some countries are affordable and clean energy, followed by no poverty, quality education along with decent work and economic growth. Altogether, it is possible to observe a differentiating advance in the partnerships for the goals and a thoughtless advance in peace, justice and strong institutions.

Although countries such as Ecuador, the United States and Peru did not submit progress data on the goals for the 2019 SDGs. It is worth noting that Canada and Costa Rica are the only countries in America that have achieved the highest number of goals; $4-7$ and $1-7$ respectively. Canada, one of the members of the Organization for Economic Cooperation and Development OECD, is the one with the best human development index (Schmidt-Traub et al., 2017), which is apparent from its inhabitants' quality of education. In this regard, Costa Rica has made great efforts to reduce poverty, as highlighted by the UNDP and the Central American Bank for Economic Integration CABEI (CABEI, 2017; Ortiz-Juérez, 2017).

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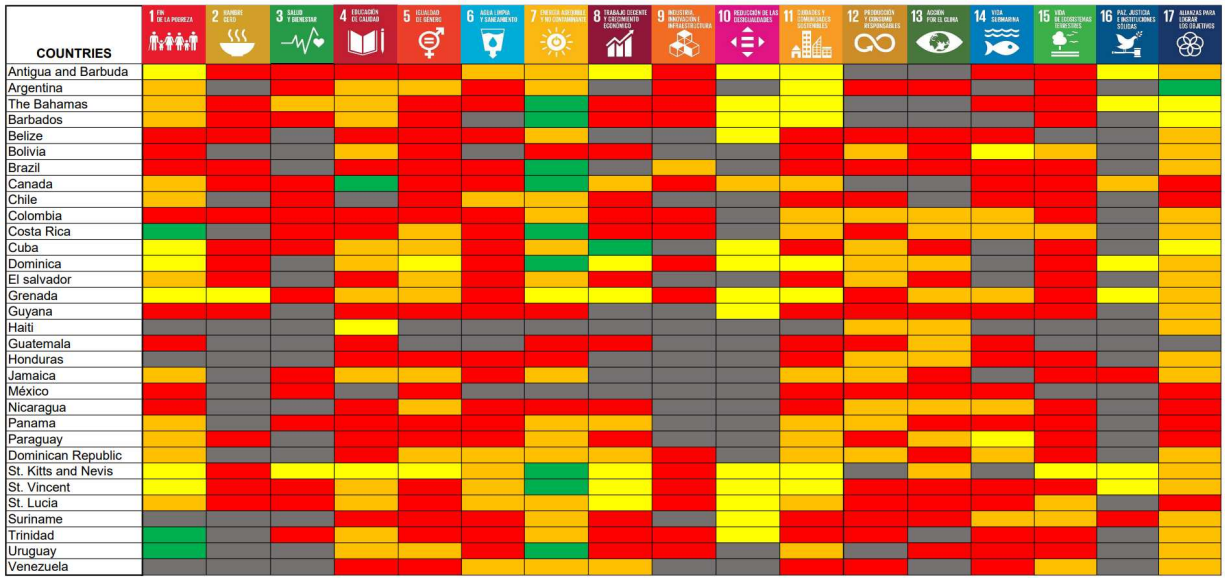


Figure 1. Overview of the analysis of the Sustainable Development Goals in America for 2019. Green: Goals achieved; Yellow: Some challenges remain: Orange: Significant permanence of challenges: Red: Progress has been minimal. Gray: no existing data. Adapted from Sachs et al. (2019).

Colombia's outlook is encouraging in objectives 7, 11, 12, 13, 14 and 17 through the implementation of clean energies, with tax incentives for those who invest in their research and use; aspect that positively impacted communities where infrastructure does not predominate and access to energy is limited (Villada et al., 2017). In the same sense, manufacturing and agricultural production has focused on less use of external sources of energy and resilience capacity (Plazas-Leguizamón and Jurado-Álvarez, 2018). Regarding objective 13, with the national climate change policy for the rural and urban sector, it seeks to mitigate the energy flows from the different productive sectors that give rise to environmental pollution (Minambiente, 2016).

On the contrary, there is a lag in the goals of reduced inequality and peace, justice and strong institutions. These aspects have been relevant in Colombia in regards of the armed conflict that have unleashed subversive groups for more than 5 decades (Rettberg, 2020), which has led to murders, forced displacements, kidnappings, extortion, moral damage and even considerable increases in growing illicit crops to obtain narcotic drugs (Rochlin, 2020).

In respect to Latin American, Haiti is the country with the least progress in meeting SDGs. However, this country shows improvement in education and climate action, as well as in sustainable production and consumption due to the abilities Haitians have acquired after the political and socio-economic crisis, which has allowed them to seek new energy sources and reduce fossil fuel impact on climate change (Perry, 2020).

The well-being of people is one of the most representative indicators in sustainable development, and has been a useful variable in the rural sector to evaluate human living, as well as sustainable livelihoods (Rasul, 2016). This aspect is well highlighted in the goal of decent work and economic growth, which in the case of America, where countries present a level of development corresponding to 3.1% (Figure 2A), 18.7 (Figure 2B), 12.5 (Figure 2C) and the highest with 37.5% (Figure 2D). This result is due to the fact that the unemployed exceeded 192 million persons for 2017, while the number for 2019 was 35 million more (Organización Internacional de Trabajo, 2018).

The assessment of economic development, climate change and the search for energy strategies have become determining aspects in the growth of regions, mainly in the rural sector. In this regard,

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Figure 3 shows the behavior that the countries have had during 2019 in correspondence to GDP per capita, the emission of greenhouse gases and the use of renewable energies, emphasizing in the first two an agglomeration of a large part of the countries in the American continent and a slight dispersion of the rest.

The GDP per capita is an indicator related to the citizens' quality of life in many cases, which in the case of Venezuela, the economic, social, political and even environmental crisis has led to great effects on this factor, giving negative digit results (Figure 2A). This is reflected in low wages, rising inflation, high prices of basic products and a dramatic reduction in purchasing power, leaving as a result that 87% of Venezuelans live in absolute poverty (Caraballo-Arias et al., 2018).

For Colombia, GDP per capita is above countries such as Canada, Brazil, Argentina and Mexico, but far below Antigua and Barbuda, as well as the Dominican Republic. In general, the countries of the American continent are characterized by presenting a grouping in this variable, with a linear performance, very similar to purchasing power parity (PPP) in countries that make up the OECD (Schmidt-Traub et al., 2017).

In the case of greenhouse gas emissions in relation to support in research and development of clean and renewable energy, the work carried out in El Salvador, Honduras and Costa Rica stands out their economic support is greater than the emission of CO_2, while in Colombia, investment has been lower. The investment of US$ 1036.8 per Kt of CO_2 released to the environment is much lower in Peru (US$ 7,160.2 / Kt CO_2) and Chile (US$ 1692.8 / Kt CO_2). However, according to CO_2 per capita emission, it is higher in North American countries such as the US$ (16.24 Tons per capita) and Canada (15.64 Tons per capita), while in South America; Venezuela (4.99 Tons per capita), Chile (4.69 Tons per capita), and Argentina (4.62 Tons per capita), being these the largest contributors (Ritchie and Roser, 2020).

Among the sectors with the highest pollution levels is the generation of energy and heat, whose CO_2 release is 42%; used in industrial activity (17%), residential (11%), services (8%) and others (4%) (Hannan et al., 2019). These aspects are relevant when it comes to consolidating new energy strategies, with less environmental impact and benefit for the most underprivileged in rural areas. According to SDG 7, this benchmark contemplates a favorable outlook for the Bahamas, Barbados, Brazil, Canada, Costa Rica, Dominica, Saint Kitts, Saint Vincent and Uruguay, which are countries that have already reached the goals (Sachs et al., 2019), according to Figure 2C.

In Colombia, access to energy is still an unsatisfied service and, therefore, life quality of the affected inhabitants is adversely affected by the use of fuels with higher polluting impact such as gasoline, oil, petroleum diesel, ethanol, mineral coal, wood, manure, polyethylene and polystyrene (Franco et al., 2008; Herran and Nakata, 2012).

3.2 Overview of the Sustainable Development Goals in Colombia

Global change in economic and environmental areas has an impact on inhabitants' daily life and on their productive, social and human dynamics; important aspects in the sustainable development of the regions. In Colombia, social, political and ecological problems have marked the pace of development, with lags in some areas more than others, reflected in poverty, hunger, low access to health, education and basic home services (Nhamo and Mjimba, 2020).

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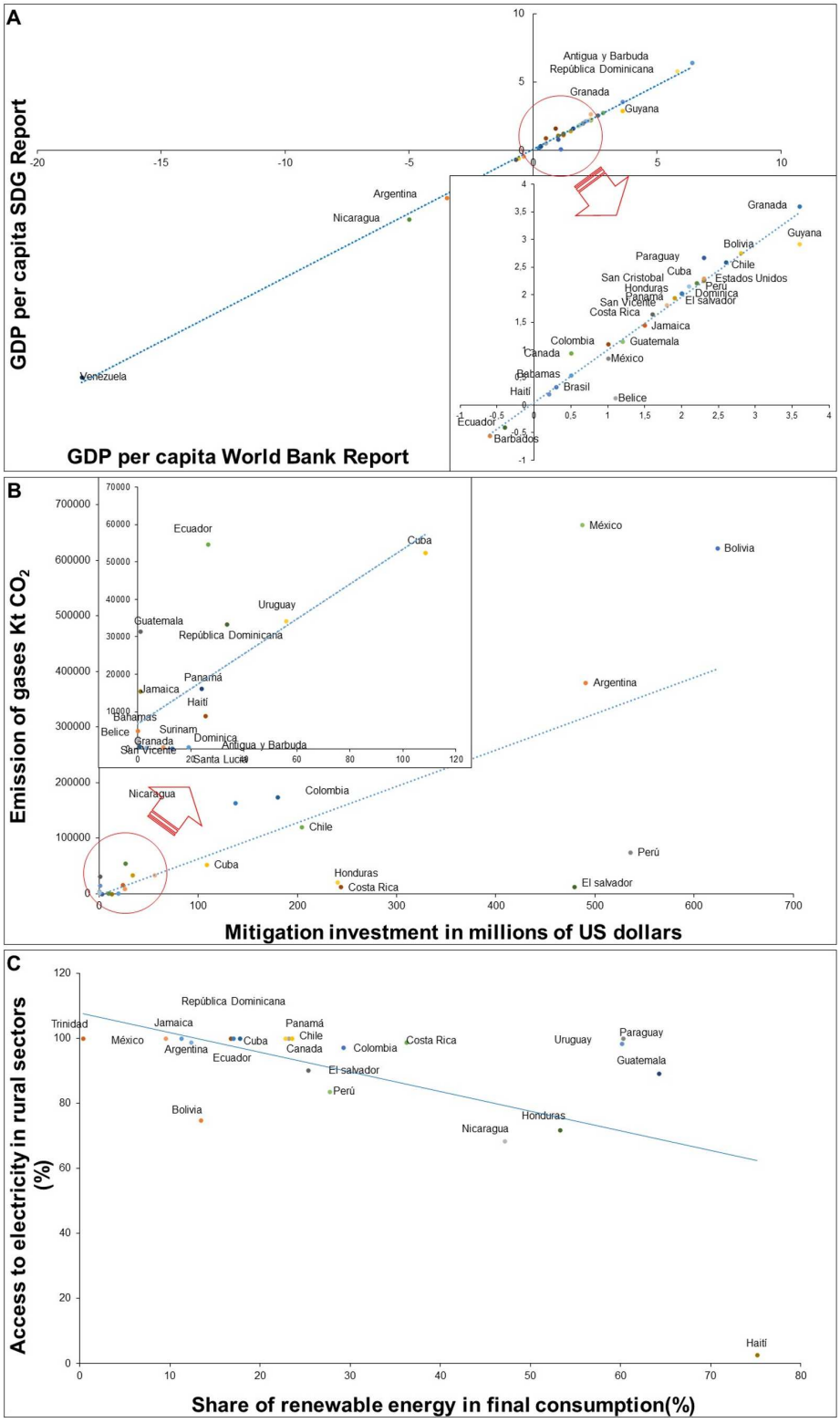


Figure 2. Relationship of SDG indicators with other indices. A: per capita analysis of countries in the American continent. B: Analysis of greenhouse gas emissions versus investment in mitigation by countries. C: Analysis of the availability of energy and the implementation of new sources.

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However, throughout history, the national government has consolidated different strategies for the implementation of territorial development plans (TDPs) and even through the National Council on Economic and Social Policy (CONPES); aspects that have been contemplated in Decree 280 of 2015 and in Law 1955 of 2019. On the other hand, international organizations such as the United Nations (UN), the Economic Commission for Latin America and the Caribbean (ECLAC), and the German Corporation for International Cooperation (Gesellschaft für Internationale Zusammenarbeit GIZ) have carried out forums, meetings, sessions, workshops and summits, in which it is intended to support nations through the SDGs in Colombia; with different development nuances from implementation to current advance (Figure 3).



Figure 3. Timeline, national and international progress regarding the SDGs in Colombia. Adapted from DPN. HLPF: High Level Political Forum. DNP: National Development Plan. TDP: Territorial Development Plan. CONPES. Adapted from Cancillería (2012)

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In this sense, Colombia has achieved autonomy in the search for strategies to fulfill the SDGs in 2030. However, the progress in the consolidation of goal indicators is still present in large gaps, and generates uncertainty to achieve the SDGs in the territories. This is how the National Planning Department DPN gathers all goal indicators for SDGs in Colombia. Data is mostly from 2016 and 2018, and according to the Colombian Ministry of Foreign Affairs, this is because the Sustainable development paradigm has not achieved the economy and society operate in an excessive and poorly balanced vertical vision, making holistic links between topics difficult (Cancillería, 2012).

In this sense, the unitary and decentralized condition of the state of Colombia ensures that subnational governments have prioritized the SDGs in regional and local planning instruments, committing resources and implementing concrete actions (Aldeanueva and Cervantes, 2019).

According to data submitted in the sustainable development reports for the years 2017, 2018 and 2019, Colombia ranks between 67 and 88 in the advancement of SDGs in recent years, whereas in the last report, it is recognized that Colombia has achieved 69.6% of goals. In this sense, the implementation of SDGs brings along synergies and antagonisms, in which some processes and people benefit as recognized by Fuso Nerini et al. (2018). In Figure 4, the degree of relationship between the SDGs in Colombia is outlined, and a higher percentage is observed in the synergy (26.7% greater than 0.9) of the ODS than the antagonism (10.4% less than 0.9) according to Pearson's Correlation Coefficient, which indicates favorability in its implementation, otherwise it would run the risk of generating perverse results, where vertical development is more important than holistic and interdisciplinary (Nilsson et al., 2016).

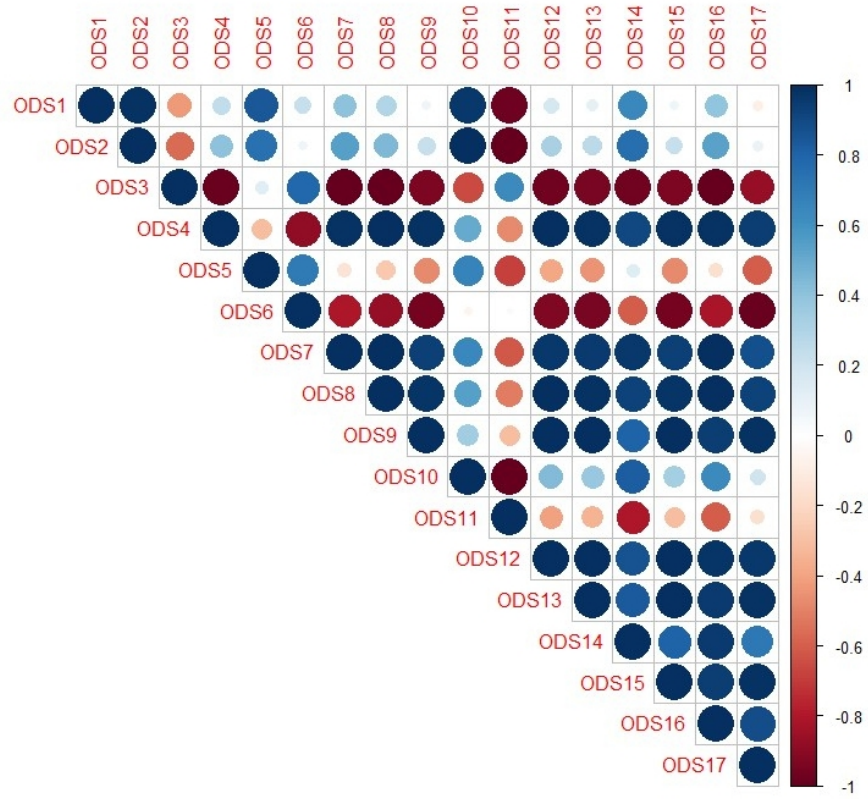


Figure 4. Correlation of SDGs for Colombia in the periods of 2017, 2018 and 2019.

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In this context, the most dynamic objectives in the synergy are: (a) Quality education, the importance of which lies in the recognition of knowledge, implementation and even its innovation in the lines of greater social dynamism (Cebrián et al., 2020); (b) Affordable and non-polluting energy with a view to new models that generate less impact and favor the resilient development of the environment (Hannan et al., 2019); (c) Decent work and economic growth, the result of which has been the international benchmark on the social well-being of individuals and the strength of nations, making it one of the pillars that requires the greatest strategic demand (Rai et al., 2019) and finally (d) Industry, innovation and infrastructure, based on the consolidation of resilient infrastructure, which allows sustainable industrialization through the innovation of products and processes (Perea-Hinestroza, 2016).

Additionally, Figure 5 shows an updated panorama (2017, 2018 and 2019) of the SDGs in Colombia, which recognizes their dynamics over time. However, the progress of the objectives varies over the years and in many cases, there is a setback in their fulfillment as observed in the final report for objective 1, 2, 5, 6 and 10. This aspect reflects gaps related to the lack of logistics, investment, support and even external dynamics (van der Waal and Thijssens, 2020).

In the same sense, there is a lag in the objectives of industry, innovation and infrastructure, as well as in the reduction of inequality, which is worrying since they do not exceed the goals of the objectives by 31.8% and 21.7% respectively, and in 2020 they would be severely affected because of the secondary consequences that the Covid-19 virus would bring, which triggered the increase in unemployment, the change in the economy, the crisis of health systems and the lack of food (Miller et al., 2020; Spinelli and Pellino, 2020), which combined with the increase in climate change indices, among which is the unpredictability of dry and rainy seasons in tropical and subtropical areas, will favor the rise in world crisis indices (Marengo et al., 2014).

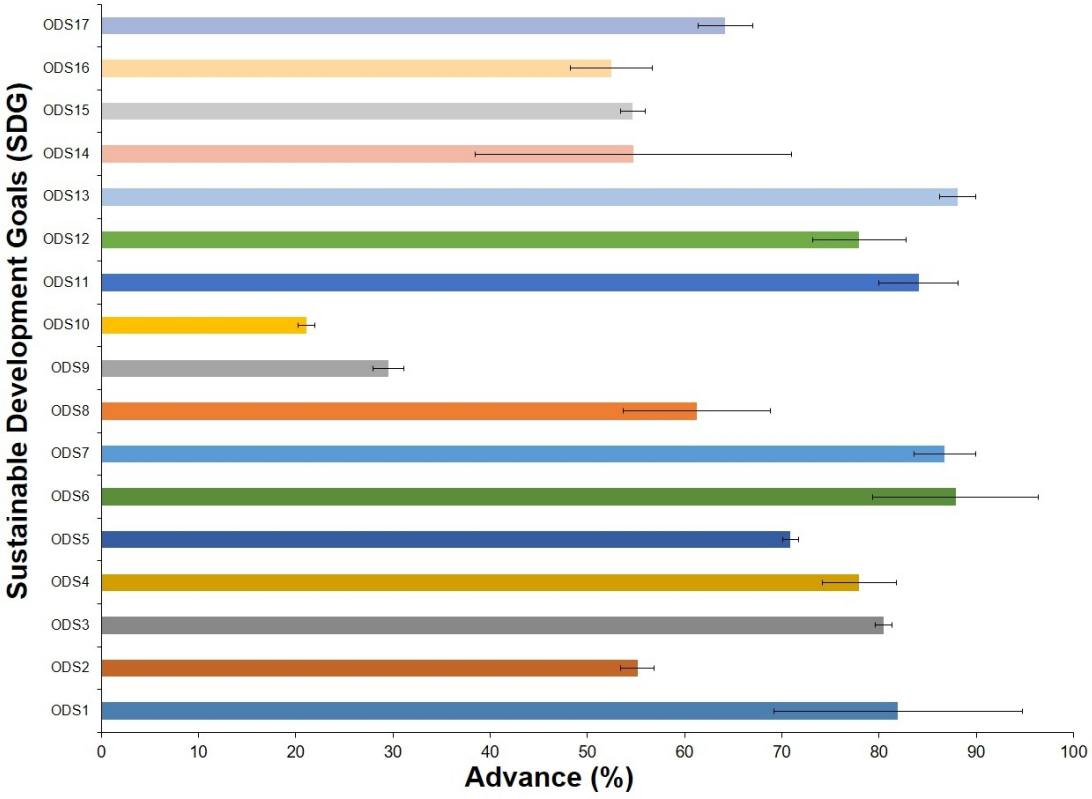


Figure 5. Progress of SDGs in Colombia during the last 3 years. Bars indicate standard deviation.

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3.3 Scientific academic context

The panorama of sustainable development goals in Colombia has been strengthened by government entities, headed by the presidency of the republic, who in 2018 made official through the National Council on Economic and Social Policy CONPES - 3918, the implementation strategy for the SDGs throughout the national territory, whose first task was their incorporation into the Territorial Development Plans TDP. This initiative had a high incorporation in 24% of the Colombian Provinces, among which are Cesar, Córdoba, Santander, Boyacá, Cundinamarca, Quindío, Nariño, and Caquetá, while a general and very general incorporation of 38% and 38%, respectively (DPN, 2018).

In this sense, the articulation in work programs developed since the fulfillment of the Millennium Development Goals (MDGs), favored the continuous work for the SDGs among the ministries, agencies and civil society, despite the fact that the entire MDG targets for 2015 were not achieved, which brought along a greater commitment to achieve in 2030.

Thus, the Ministry of Science, Technology and Innovation consolidated in 2017 the first advance in the relationship between knowledge and the SDGs (Chavarro et al., 2017), in which they analyze the goals that were met and remained to be met in the MDGs, the strategies to be implemented for the SDGs, as well as the current panorama and the relationship between goals. In 2018, the National Policy on Science and Innovation for Sustainable Development (Resolution 0614 of 2018) entitled "Green Book 2030" was consolidated, in which the voices of citizens, businessmen, and national and international academics were compiled, whose theme focuses on the holistic application of science as a tool for knowledge and technology, as a support strategy, taking society as the main actors, and politics as an interdisciplinary aspect to achieve sustainable and resilient development with the environment (COLCIENCIAS, 2018).

Faced with this situation, different research centers and higher education institutions have come together, and with this, they have undertaken projects that seek to involve the SDGs in the productive sector, supported by the interdisciplinarity of science with academic and scientific actors who conduct knowledge to be applied in different fields, in order to contribute to the fulfillment of the goals (Perea-Hinestroza, 2016).

In this regard, research centers and higher education institutions have advanced in particular studies that contribute to the SDG indicators; an aspect that can be seen in the Gruplac and Cvlac of Colombian researchers (Figure 6).

Table 1. Research groups developing research on SDGs.

Research Group	Research area
Studies in urban and business sustainability -SuyE	Urban-regional sustainability
	Sustainable regional development
	Sustainability of organizations
Sustainable Regional Development	Territorial management
	Social capital
Research Group of the Latin American School for Cooperation and Development -GIELACID	National cooperation and financing for the development
	Society and strategic development sectors
Group of Legal Research Universidad de Medellín	Law and society
Phytosanitary and Biological Control Unit	Bioactive substances for agriculture
	Bioprospecting and microbial ecology
Environmental Management and Modeling Research Group (GAIA)	Modeling of environmental systems
	Biological treatment of waste and sewage
	Applied environmental microbiology
	Ecology of coastal aquatic systems
GINEI Infectious Diseases Research Group	Infectious disease epidemiology
Applied Geoinformatics	Geoinformatics and climate change
Raimundo de Peñafort	Fiscal sustainability
	Democratic sustainability

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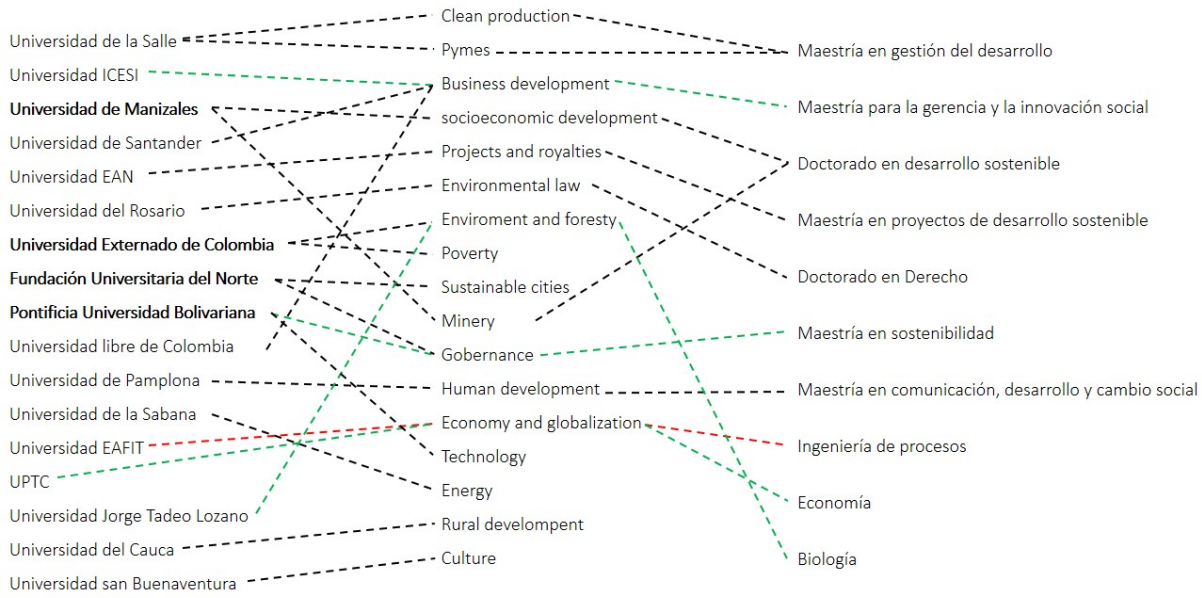


Figure 6. Analysis of the research work developed by national universities, strategic areas and academic programs.

Universidad de Manizales, Universidad Externado de Colombia, Fundación Universitaria del Norte, and Pontificia Universidad Bolivariana carry out more than one process that involves the implementation of SDGs, within projects that link the academic programs, and whose purpose has been highlighted by researchers who have a track record in the subject, and research groups that offer support with SDGs in academic-scientific work. However, there are research groups (Table 1), which, through their lines of research, route sustainable development projects, supported by students, academics and scientists, who deliver knowledge to the productive sector or civil society (Rodríguez-Rojas et al., 2019).

4 Conclusions

When analyzing the evolution of the Sustainable Development Goals (SDGs), the contributions of alliances on economic, social, political and environmental aspects at the local level are highlighted, for which it is necessary to strengthen interdisciplinary strategies in order to achieve transdisciplinary contributions for the benefit of local communities, new generations and the territories, through the integration of issues on affordable and clean energy, poverty, quality education, decent work and economic growth.

Among the actors participating in work teams, the leadership of the academic and research processes is required, focused on the holistic application of science as a knowledge and technology tool. Moreover, as a support tactic, the active participation of local communities is essential for their contextualization, in order to contribute to the particular resilience processes, evidenced by people's livelihood components and well-being, as indicators of sustainable development. To this end, the importance of intergenerational interaction is highlighted as a strategy for the evolution of generational renewal at the academic, research and rural community levels; thus, addressing economic progress with emphasis on the relationship between climate change, technology, lifestyle, decentralized governance, poverty-inequality and responsible production, according to the regional agricultural vocation and its natural reserves to counteract problems on the energy flows of the productive sectors, causes of environmental pollution, through the use of clean energy.

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In this way, it is possible to show the need to address economic development, climate change and the search for energy strategies for the rural sector, through the consolidation of teams from different areas of knowledge as support for research on social, technical, political and environmental problems, as they are the causes of the backwardness of the localities, as evidenced by the levels of poverty, loss of security and sovereignty food, in the same way inequity for quality access to rights such as health, education and basic services.

Sustainable development is the contextualized added of social, environmental, cultural and economic indicators, which in a systemic way have been made visible through significant local experiences, where the resilience of natural resources is relevant for the benefit of the community.

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