

Geological Management For Coal Mining Sustainability

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Abstract

The objective of this article is to point out the importance of sustainable development in coal mining in Norte de Santander through a Geological Management, a fundamental stage in the exploration process in coal projects; With a qualitative perspective, it applies exploratory research to analyze results on the current situation of the coal sector at a national and regional level in relation to the social, economic and environmental dimensions, results that show a vulnerable sector in terms of sustainability due to the lack of a Geological exploration. . The importance of sustainable development is presented according to the 2030 agenda of the United Nations according to the Eight Millennium Goal that points towards "Promoting sustained, inclusive and sustainable economic growth,

Keywords: Sustainable development, Geology, Productivity, Exploration, Exploitation, Competitiveness

Introduction

In Norte de Santander, coal mining activity is a tradition that characterizes the region, a sector that has contributed considerably to economic and social development despite not adequately carrying out exploration processes prior to exploitation based on geological studies that ensure viability. economic, social and environmental aspects of coal mining projects.

In accordance with these considerations, coal businessmen, mining authorities, educational institutions and communities in the areas of influence must direct actions towards sustainable development in compliance with Goal Eight contemplated in the United Nations 2030 Agenda, a challenge that is the central theme of this article whose methodological proposal is based on exploratory research within a qualitative perspective for the analysis of the socio-economic situation of the coal mining sector in Norte de Santander as it appears in a first section and the analyzes of sustainable development according to to the United Nations agenda as it appears in the second section; the conclusions are found in the third section, which summarize the relevant findings that deserve to be taken into account.

It should be noted that based on secondary sources of information that are related in the bibliographical references that appear in the last section, the development of this article was possible through a search and selection process of data that is interpreted in the document.

Socioeconomic situation of Coal in the Department of Norte de Santander. It should be noted that the Department of Norte de Santander has a mining tradition towards the exploitation of coal, an activity that has played a significant role in the economic and social development of the region, however, its productivity and competitiveness are threatened because the The initial phase of exploration is not carried out adequately through actions aimed at finding coal deposits that present favorable geological conditions, such as mineral potential and quality. Added to this lack of exploration are "illegal extractions" (Ministry of Mines and Energía, 2005, p.48) due to business informality that generates a negative social impact, "added to the ignorance of the local authorities regarding their obligations in this regard and the support of legal producers and marketers, who sometimes rely on these extractions to satisfy the demand of their clients, has made it difficult to eradicate this activity." (p.48)

By way of illustration, it should be noted that the role of the Exploration stage in a mining project must be in accordance with current legislation in this regard, such as Law 685 of 2001, by which the Mining Code is issued regarding Exploration Works. Article 78 states: "The studies, works and works to which the concessionaire is obliged during the exploration period by subsoil methods, are those necessary to establish and determine the existence and location of the contracted mineral or minerals, the geometry of the deposit or deposits within the concession area, in economically exploitable quantity and quality, the technical feasibility of extracting them and the impact that these works and works may cause on the environment and the social environment".

In view of the foregoing, permanent coordination is required between mining and environmental authorities and the implementation of strategies on the part of the State aimed at greater productivity and competitiveness of coal mining activity that aim to "extract minerals under technical, environmental parameters, economic, labor and social aspects since, through a strong institutional articulation and the commitment of the mining companies and workers with the rigorous application of the regulations, both the governability and governance of the sector, as well as the management and administration of the country's mining resources" (Ministry of Mines and Energy, 2016, p.08)

According to these considerations, Geology plays a significant role as a "science that studies the composition and disposition of the materials that constitute the terrestrial lithosphere, its nature, its situation and the causes or phenomena that originate this disposition and the effects of the agents that alter it." (Minminas, 2015, p.76), a discipline that implies a surface Geology referred to "exploratory studies aimed at selecting promising areas within a deposit based on existing geological information on the surface. The preliminary evaluation of the results obtained in the surface exploration allows us to decide and define the continuation of the exploration itself". (Minminas, 2015, p.76).

The above process should be based on a regional Geology that includes studies on "lithostratigraphic units and their relationship with tectonic events, igneous and mineralization processes that occurred in a wide region, country or continent. It generally involves petromineralogical studies of sedimentary, volcanic and igneous rocks, geochemical analysis of

rocks, geochronological dating, structural analysis and tectonic evolution, relationship of magmatic episodes and tectonic phases with periods of mineralization, combined studies of stratigraphy and other geosciences" (Minminas, 2015 , p.76).

In view of the foregoing, it also implies a Geology of the subsoil that consists of the "technical exploration carried out by means of excavation works of shafts, opening of trenches and galleries or soundings with drill; and through geophysical prospecting methods" according to the cited source; Thus, this subsoil geology aims to locate geological structures and achieve "through the evaluation of the results, a first three-dimensional model of the areas of the deposit selected in the surface geology phase; model on which areas are selected again that offer the best advantages from the point of view of economic geology, for a possible mining development" (Minminas, 2015, p.76).

It should be considered that mining development must have a focus on corporate social responsibility, as consolidating the social well-being of communities in coal mining areas is one of the purposes of the mining authority in Colombia, as evidenced by the development plan, stating that "beyond Although the sector is generating half of exports and two thirds of foreign direct investment, its greatest contribution in terms of development is the generation of resources for social and productive investment" (National Planning Department, 2011, p.230),

In this order of ideas, the development plan affirms that "the potential of extractive activity to generate economic growth, but with little analysis of the conflicts generated by high growth rates, in the midst of critical conditions of human development in the areas that generate the wealth". (Rudas, 2014, p.35); This mining and hydrocarbons sector contributes 11% of the total added value of the entire country, "it only occupies around 1% of the total labor force, barely generating 81,000 new jobs in said period." (Rudas & Espitia, 2013, p.19)

Regarding the environment, "one of the aspects that has generated repeated debates about the open-cast coal mining activity that is taking place in Colombia refers to the effects that this exploitation may have, or is having, on the environment and , in particular, on human health" (Rudas, 2014, p.19). In this regard, it is worth noting that:

The health of the workers and the population that lives in the areas of influence of the extraction, transport and shipment of coal, there are no known studies in this regard carried out or promoted by the mining, environmental, labor, health and of social security. (Rudas, 2014, p.22). In economic matters, it is worth noting that Colombia is the main coal producer in South America with a reserve of 15,500 million tons (Minminas, 2016, p.53) and a production whose volumes have remained stable in the last five years (2011-2015).), but in Norte de Santander it has increased at an annual cumulative rate of 2.5%

In relation to the Gross Domestic Product (GDP), the mining sector represents an average participation of 2.2% of the Colombian GDP, generating \$9.5 billion in 2010 to \$10.6 billion in 2015. "In that same period of time, the participation of coal in the GDP mining was approximately 65.9%, while metalliferous metals and non-metallic minerals participated with 18.9% and 15%, respectively" (Minminas, 2016, p.25).

The export dynamics of coal indicates that it is a sector integrated into the world economy, in

2016 the country exported 17.3 million tons (Minminas, 2016, s/p) which is equivalent to 20.3% of the produced and the department of the total produced exported that year, 69% to various destinations such as Turkey, the Netherlands, the United States and Spain, among others. In terms of prices, thermal coal has shown a downward trend in prices in recent years, given that in 2009 it was quoted at \$94,359 a ton and in 2013 at \$93,167, which represents a drop of negative 0.32% according to the cumulative rate. per year and coke coal of \$149,000 per ton in 2009 was quoted in 2013 at \$256,667 per ton, which represents an annual cumulative increase of 14.6% according to data from UPME (2014).

According to the National Mining Agency (ANM) and the Colombian Mining Association (ACM) "they project that the industry will be reactivated in 2017, as long as the sector is accompanied and supported with legal certainty and competitiveness." (Portfolio, 2017, s/p).

Sustainable development

In the new millennium, profound transformations have been generated in terms of production, energy and consumption, which leads to a new paradigm known as "sustainable development" that points to the economic, social and environmental dimensions, given "the slow global economic growth, the social inequalities and environmental degradation that are characteristic of our current reality present unprecedented challenges for the international community" (CEPAL, 2017, p.08)

The previous reflection involves the concept of sustainability which is "based on the balance of the resources of a species with its environment, as well as the exploitation of one or more resources below the limits of regeneration and renewal, through the values of citizen identity and the sense of belonging over time" (De Hoyos, JE and others, p.15), a balance that is reflected through economic, social and environmental effects, where "the economy depends on the environment and changes in the environment influence the economy, which is why they are interdependent" (Contreras, et al., 2012, p.107)

According to these considerations, in 1991 the United Nations Environment Program (UNEP), entitled "Caring for the Earth", as the Second World Conservation Strategy, defined Sustainable Development according to Gudynas, (2002, 54-55) cited in Gómez (2004, p.136) as:

"the improvement in the" quality of human life without exceeding the carrying capacity of the ecosystems that sustain it (...) This strategy makes it clear that a development of this type requires profound cultural changes, and, with that objective, it proposes nine Principles for a "sustainable society": respect and care for the community of living things, improve the quality of human life, conserve biodiversity, minimize the depletion of non-renewable resources, stay within the carrying capacity of the Earth modify personal attitudes and practices, empower communities to care for their own environment, provide a national framework for the integration of development and conservation, and forge a global alliance" (Gómez, 2014, p.126).

In accordance with the previous purposes, in 2016 the Economic Commission for Latin America and the Caribbean (ECLAC), in order to eradicate poverty in the Region, accepted the document "Transforming our world: the 2030 Agenda for Sustainable Development" of the United Nations General Assembly, which includes the Sustainable Development Goals to "build on existing

follow-up and review mechanisms at the regional level and to leave sufficient policy space, encourages all Member States to determine what will be the the most appropriate regional forum for their participation” (CEPAL, 2016, p.02); This new development agenda "represents an opportunity to move towards stronger commitments to eradicate poverty,

Within this framework, the 2030 Agenda formulates Goal Eight (8) which consists of "Promoting sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all" (ECLAC, 2017, p.29) , an objective that identifies goals to achieve it such as:

“Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including by focusing on high value-added and labour-intensive sectors” (p.30)

“Progressively improve, by 2030, the efficient production and consumption of global resources and seek to decouple economic growth from environmental degradation, in accordance with the 10-Year Framework of Programs on Sustainable Consumption and Production Patterns, starting with countries developed” (p. 30)

“Empirical evidence shows that the strategic orientation of the company is the result of the work of senior management, whose leadership seems to bring the organization in tune with global initiatives such as the Global Compact and the Millennium Goals. This alignment of the company with international postulates is manifested in the identification and prioritization of aspects that affect its performance (table 3), which are evaluated based on different international standards of corporate sustainability” (Polanco et al., 2016, p.189)

According to Fedesarrollo, it is considered that mining activity is not compatible with the concept of sustainable development, "recalling various practices from the past that have been questioned in terms of transparency and accountability, as well as due to the dramatic environmental and social consequences that have left in its path in some regions of the world" (Fedesarrollo, 2014, p..12), however the Colombian State makes considerable efforts to harmonize the coal sector with the environment, so Decree Law 4131 of 2011 on Service Colombian Geological (SGC). The legal nature of the Colombian Institute of Geology and Mining (Ingeominas) was changed and it was called the Colombian Geological Service, attached to the Ministry of Mines and Energy, as part of the National System of Science, Technology and Innovation (SNCTI).

“contribute to the economic and social development of the country, through research in basic and applied geosciences of the subsoil, the potential of its resources, the evaluation and monitoring of threats of geological origin, the integral management of geoscientific knowledge and nuclear and radioactive research and control” (Minminas, 2016, p.25)

In this sense, mining to achieve sustainable development must direct its activity towards four dimensions such as social, economic, environmental and governance, dimensions that must be supported by a fundamental pillar such as Geological Management in coal mining projects through through a management oriented to the use “of the reproductive and regenerative capacity of the different types of capital: human, natural, physical infrastructure, economic and

financial and, finally, institutional". (Ramirez and others, 2004, p, 59)

Within this framework, the management of the Geological Management must be measured based on the guidelines of international entities and research institutes on sustainability, applying indicators to "establish the state of the air, soil, water, biodiversity, climate change, vulnerability to natural disasters, waste generation, institutional capacity to deal with environmental problems, community participation in solving environmental problems" (Arias, 2006, p.226).

Some experiences of underground coal extraction, in the case of Norte de Santander, show that "there are at least seven adverse events with frequent occurrence, which, in the absence of prevention, monitoring and timely treatment, make the territory more vulnerable" (Guerrero and another, 2016, p.71), some of these risks are identified as soil contamination with metals, ash accumulation, tributary infiltration, deforestation, soil destabilization, aesthetic and landscape deterioration, and erosion, according to the source. cited.

Given these considerations, it is important to mention that "at a social level, the recovery of some waste can give rise to new transformation processes that will generate new jobs. Likewise, the damage to the environment that can be avoided has a positive impact on the quality of life of society" (Cervantes Torre-Marín et al., 2009, p.69).

The management of the Geological Management must anticipate conflicts through citizen consultations and the technical evaluation of possible environmental impacts, anticipating the risks in this regard and not once the projects are already a fait accompli and have begun to be executed, " This characteristic makes project management difficult, since it facilitates the adoption of intransigent positions based on mutual distrust on the part of the affected communities, even leading to legal claims against the activity carried out (Acuña et al., 2016, p. 96)

It should be considered that the concept of Management has occupied a relevant place in society, given its implications for the social and economic development of nations, "it is the organ of society specifically in charge of making resources productive, that is, responsible for the organized economic progress, reflects as a consequence, the basic spirit of this era" (Drucker, 1954, p.15), for this, the Geological Management must attend the process of planning, organizing, directing, delegating, integrating, coordinating, and control self-directed work teams, a process aimed at meeting the objectives, more focused on the development of business strategies that strengthen relationships with current and potential customers (Correa, Erazo, Moreno & Ladino, 2014, p.54),His role implies a management focused on innovation that allows, in addition to perceiving changes in the environment, adjusting to them or taking advantage of them, given that:

Innovating from the managerial point of view is perhaps the biggest challenge for today's Manager, implementing business models, highly competitive strategies, forming high-performance work teams, meeting goals and indicators, decision-making, among other aspects (...) . Today the Manager faces a competition that innovates, that creates, that knows the rules, that unites to create blocks of power and to rationalize the effort. (Correa et al., 2014, p.60)

In view of the foregoing, the Geological Management aims to detect new business opportunities in coal deposits, as well as in the negotiation, subscription and administration of concession contracts at a national and international level; evaluate and propose new prospects according to coal exploitation potentials; plan, execute and supervise the activities inherent to exploration according to technical, environmental and safety at work standards; plan and analyze Geology, Geophysics and Geochemistry projects in order to increase and optimize production: formulate production forecasts; Identify training needs of the staff under your charge. manage and assess occupational and environmental risks, prepare and present Exploration results reports to Management

The organizational parameters of a Geological Management in mining projects are based on the delegation of responsibilities or decentralization, which implies delegation of authority, understood as "the discretion granted to individuals to apply their own judgment to decision-making and turn of instructions. (Koontz, 2009, p.313); projects considered as an open system of social order, must respond to the approach that "every organization is a managed combination of technologies and people, so that both parties are in reciprocal interrelation, in addition to being considered an open system, it is also understood as a structured socio-technical system" (Chiavenato, 2004, p.16)

In view of the foregoing, it should be noted that the creation of the National Mining Agency - ANM through Decree 4134 of 2011, contributes to the institutional strengthening of the mining sector in Colombia, an entity that as a technical mining authority must report to and depend on the Directorate Business Mining of the Ministry of Mines and Energy, given that "it seeks to promote the sector with transparency, efficiency, environmental, social and productive responsibility" (National Mining Agency, 2015, p.1),entity that must integrate within its structure the Geological Management responsible for Environmental Management that allows integrating the level of performance of the company in relation to the aspects that are considered of vital importance to determine the response capacity of mining projects before the environmental responsibilities through the Environmental Management Plan and based on the provisions of the Ministry of Environment and Sustainable Development, 2017, Decree 75 of 2017, related to "Forced Investment for the use of Water taken directly from natural sources, which indicates in its .Article 1 that "sustainable use projects: are projects that include productive activities, which from the natural supply of the territory generate marketable goods and services and contribute to conservation,restoration and sustainable use of ecosystems and agro-ecosystems, to the generation of social welfare and the strengthening and diversification of the regional and local economy in a sustainable manner"

Faced with all the above considerations, the educational system plays a considerable role in sustainable development processes, "particularly when it refers to the link between Environmental Education and Sustainable Development. This emphasizes not only the aims and objectives of Environmental Education , but above all in the teaching and learning processes oriented from a constructivist perspective" (Morón et al., 2017, p.251), in addition, "a new style of development is required: a progressive structural change focused on equality and environmental sustainability and based on social coalitions and pacts for global, regional and national governance. This change requires a long-term vision and a new correlation of social and political forces" (CEPAL, 2016, p..

Finally, nations and regions must internationalize in the face of globalization with actions towards economic, social, environmental and governance sustainability, taking into account that

“The possibility of progressive structural change will depend on the choice of each society between two paths: maintaining the trajectory of the past, unsustainable and associated with a distributive conflict of increasing intensity, with social, institutional and political fragmentation, or moving towards a new style of development, in which collective action and long-term agreements in democratic societies promote equality, transparency and participation, with a focus on productivity, quality employment and care for the environment, based on the dissemination of the new technologies in a great environmental boost” (CEPAL, 2016, p.78)

conclusions

The Economic Commission for Latin America and the Caribbean (ECLAC), in order to eradicate poverty in the Region, adheres to the guidelines for Sustainable Development based on the 2030 Agenda of the United Nations General Assembly, which includes Sustainable Development Goals to “take advantage of existing follow-up and review mechanisms at the regional level and to leave sufficient policy space, encourages all Member States to determine the most appropriate regional forum for their participation”

Within this framework, the 2030 Agenda formulates Goal Eight (8) which consists of "Promoting sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all" Coal mining at the national and regional level It is a sector that contributes significantly to the social and economic development of the country and offers excellent business opportunities, however, coal productivity in Norte de Santander is threatened due to the lack of an effective Exploration process that generates added value through processes aimed at sustainable development throughout the production chain.

Mining informality, mainly associated with small and medium-scale mining in the department, is notorious and the State does not exercise effective action to combat this problem. The purpose of this article is to provide a guide that points to the sustainable development of coal mining projects in the social, economic, technical and environmental aspects through Geological Management oriented towards satisfying the expectations of all stakeholders. Stakeholders interested in coal mining activity such as internal and external customers, shareholders, managers, suppliers, competent authorities and the community in general

The lack of culture towards exploration in mining concession projects in the region is evident, due to the lack of further geological studies aimed at determining the potential and quality of the deposit, insufficient application of productivity indicators, deficient information system; greater foresight through prospecting processes.

The primary role of the Geological Management is to generate value by optimizing the levels of productivity and competitiveness for coal companies through geological, geophysical and geochemical methods. The skills of a Geological Manager are identified in the ability to plan, direct, execute and control exploration activities in coal mining with a view to sustainable development The area of Geology in coal mining projects is an open system of social order , which is an integral part of a mining organization and allows the interrelation of technologies and the human being, therefore, it is considered as a structured socio-technical system.

The current knowledge society demands a generation of value in all business areas, thus, through a Geological Management, people with skills that allow them to be personally effective to achieve the objectives in mining concession projects are required. The Geological Management must be directed by the National Mining Agency of the Department of Norte de Santander, an entity that must provide the basic guidelines for its correct operation.

It is recommended to socialize this article with coal mining businessmen from Norte de Santander to highlight the importance of Geological Management in the generation of social, economic, technical and environmental value as key factors of sustainable development. The Geological Management must direct its management towards the satisfaction of the needs and expectations of the actors involved in a mining project, guaranteeing safety at work, developing training programs and community participation. The Geological Management must achieve economically exploitable quantity and quality to generate sustainable development, in addition, determine the technical feasibility of extracting the mineral and assess the impact that mining activity may cause on the environment and the social environment

To generate value, management focused on the application of geological, geophysical and geochemical methods is required to achieve the quantity and quality of coal expected and evaluate through environmental indicators compliance with the Environmental Management Plan and preservation of natural resources.

The management of a Geological Manager must be based on the Mining Code in order to focus this activity towards the proposed objectives and align it with the Management and with the Exploitation area.

The Geological Manager must plan, execute and control the geological, geophysical and geochemical activity based on an investigative process that allows him to characterize the environment and the conditions of the deposit Develop Training Programs in geological survey, coal characteristics and emergency systems in security and environmental protection and training programs for entrepreneurs through the Business Assistance Centers - CAE.

Implement Occupational Health Programs and training programs in environmental sanitation in coal mining projects.

Promote the Participation of the population of the area of influence in the Environmental Management Plans. Through prior consultation.

Promote corporate social responsibility for the fulfillment of commitments with human resources and improvement of the living conditions of the population in mining areas involving prior consultation processes for citizen participation prior to exploration in coal mining projects, led by by the Geologist and his team

References

Acuna, Guillermo; Serrano, Ricardo, 2016, Socio-environmental Energy Conflicts in Latin America: Regarding Renewable Energies in the 2030/UN Agenda, Konrad-Adenauer-Stiftung. Sustainable Development and Energy Matrix in Latin America The

- universalization of access to clean energy
National Mining Agency. (2015). Mission and vision agency. Retrieved from:
<https://www.anm.gov.co/?q=agencia/mision>
- Arias, Fabio 2006, Sustainable development and its indicators Society and Economy Magazine, no. 11, p. 200-229 University of Valle Cali, Colombia
- Cervantes Torre-Marín, G.; Sosa Granados, R.; Rodriguez Herrera, G.; Robles Martínez, F., 2009. Industrial ecology and sustainable development Engineering, vol. 13, no. 1, January-April, 2009, pp. 63-70 Autonomous University of Yucatan Merida, Mexico
- Economic Commission for Latin America and the Caribbean, (ECLAC), 2016. Thirty-sixth Period of Sessions, Resolution of Mexico creating the Forum of the Countries of Latin America and the Caribbean on Sustainable Development, Mexico
- Economic Commission for Latin America and the Caribbean (ECLAC), 2017, Agenda 2030 and the Sustainable Development Goals, An opportunity for Latin America and the Caribbean, Santiago de Chile.
- Economic Commission for Latin America and the Caribbean (ECLAC), 2016, Horizons 2030: equality at the center of sustainable development. Summary (LC/G.2661/Rev.1), Santiago, Chile
- Congress of the Republic of Colombia, 2001, Mining Code, according to Law 685 of 2001, Bogotá DC
- Contreras Soto, Ricardo; Aguilar Rascón, Oscar Cuauhtémoc, 2012, Sustainable development (historical profile) Magazine of the Research Center. La Salle University, vol. 10, no. 37, p. 101-121 La Salle University Federal District, Mexico
- Correa, N., Erazo, E., Moreno, J. & Ladino, W. (2014). How Decision Making based on Perception influences the Company Standard Gold de Colombia SAS. University of Medellin. Medellin Colombia.
- Chiavenato, I. (2004). Introduction to the general theory of administration. Mexico: McGraw-Hill.
- DeHoyos, JE; Álvarez Vallejo, A. and Jiménez Jiménez, J. (2010). The sustainable competitiveness in the urban-architecture design the case: the urban strip in western Hidalgo Toluca. Quivera, Mexico: UAEM, vol. 12, no. 1, January-June, pp. 14-25
- National Planning Department. (2011). National Development Plan. Bogota: DNP.
- Drucker, P. (1954). Business Management. New Jersey: Edhasa.
- Fedesarrollo, 2014, Mining and Environment in Colombia, Bogotá DC
- Gómez Contreras, Jennifer Lorena, 2014, From Sustainable Development to Environmental Sustainability, Faculty of Economic Sciences Magazine: Research and Reflection, vol. XXII, no. 1, p. 115-136 Nueva Granada Military University Bogota, Colombia
- Guerrero Useda, Maria Eugenia; Pineda Acevedo, Vanessa, 2016, Soil Contamination in the Mining Zone of Rasgatá Bajo (Tausa). Conceptual Model Science and Engineering New Granada, vol. 26, no. 1, p. 57-74 Military University Nueva Granada Bogota, Colombia
- Koontz, H. (2009). Administration: a global perspective. Mexico: Mc Graw-Hill., Bogota
- Ministry of Environment and Sustainable Development, 2017, Decree 75 of January 20, 2017, Modifies Decree 1076 of 2015, Sole Regulatory Decree of the Environment and Sustainable Development Sector, in relation to the "Forced Investment for the use of Water taken directly from natural sources.
- Ministry of Mines and Energy. (2015). Mining Technical Glossary. Bogota:
- Ministry of Mines and Energy., 2005, Energy Mining Planning Unit - UPME, The Colombian Coal Chain. Bogota: The Ministry.

- Ministry of Mines and Energy. (2014). Statistical Bulletin of Mines and Energy 2000-2013, Mining Sector. Bogota: The Ministry.
- Ministry of Mines and Energy, 2016, Colombian Mining Policy, Bases for the mining of the future Republic of Colombia, Bogotá DC
- Ministry of Mines and Energy, 2016, Coal Production and Exports in Colombia First Quarter 2016, Bogotá DC
- Moron-Monge, Hortensia; Morón-Monge, M^a Carmen, 2017, Heritage Education or Environmental Education? Converging perspectives for science teaching Eureka Magazine on Science Teaching and Dissemination, vol. 14, no. 1, p. 244-257 Association of Teachers Friends of Science: Eureka Cádiz, Spain
- United Nations, 2015, General Assembly Resolution, Transforming our world, 2030 Agenda for Sustainable Development, New York
- Polanco, Jorge; Ramirez, Fabian; Orozco, Martha , 2016, Incidence of international standards in corporate sustainability: a senior management perspective Estudios Gerenciales, vol. 32, no. 139, p. 181-192 ICESI University Cali, Colombia
- Portfolio, 2017, 2017 could be a historic year for mining, available at <http://www.portafolio.co/negocios/mineria-en-colombia-tendria-repunte-en-2017-503428>
- Ramirez Trevino, Alfredo; Sanchez Nunez, Juan Manuel; García Camacho, Alejandro, 2004, Sustainable Development: Interpretation and Analysis Magazine of the Research Center. La Salle University, vol. 6, no. 21, p. 55-59 La Salle University Federal District, Mexico
- Rudas, G. & Espitia, J. (2013). The paradox of mining and development. Departmental and municipal analysis for the case of Colombia. Bogota: Sn
- Rudas, G. (2014). Notes on large-scale coal mining in Colombia, contained in Large-scale coal mining in Colombia: economic, social, labor, environmental and territorial impacts Friedrich-Ebert-Stiftung (FES). Bogota: Sn
- Colombian Mining Information System, SIMEC, 2017, Statistics, Bogotá DC