Socioeconomic and environmental conflicts caused by ecological distribution in the Sinifaná Coalfield, Colombia

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Abstract

This paper analyzes ecological distribution, with a focus on the socioeconomic and environmental conflicts generated by coal exploitation in the Sinifaná coalfield (SCF), in Antioquia, Colombia. The methodology incorporated a descriptive approach which focused on socioeconomic and environmental conflicts, and an analytical approach with a relational emphasis. The hypothesized relation between socioeconomic and environmental conflicts, ecological distribution and the Sustainable Development Goals was corroborated. In conclusion, the main conflict present in the study area surrounds the environmental unsustainability that derives from informal and illegal mining practices. This causes countless socioeconomic and environmental conflicts that are impacting the well-being of people living in the SCF.

Keywords: sustainable development; ecological distribution; ecological-distributive conflicts; coal exploitation, mining; natural resources.

1. INTRODUCTION

In recent years, coal exploitation in Colombia has intensified, due to increasing natural resource prices and more demand for energy on the part of developed countries, and additionally, because of state policies established to attract foreign investors to the producing countries (Portafolio, 2012, p. 1). Furthermore, new mining projects have been generated with the goal of exploration and exploitation.

Antioquia's participation in the total coal production of Colombia represents 0.11% (5.105 tons) and is concentrated at the Sinifaná coalfield (SCF), with a production of 2,485 tons (Amagá Municipality partial data of 2018; Sistema de Información Minero Colombiano y Agencia Nacional de Minería [SIMCO], 2018, p. 22). This encompasses a territorial extent of 236 km2, composed of the municipalities of Amagá, Angelópolis, Fredonia, Titiribí and Venecia (Gobernación de Antioquia, 2007, p. 9).

In the SCF, the type of mining uses tunnels or is subterraneous, which originated in the 1990s and has brought a multitude of conflicts for the populations where the mining exploitation is practiced, which are not only environmental but social and economic. As Bebbington argues (2009, p. 24): "The spatial expansion of mining does not happen on empty land. On the contrary, it happens on already occupied land which is someone else´s

property, lands that have cultural and historical significance for their inhabitants and lands that are the source of diverse natural assets that sustain the life strategies of these people." Attitudes towards such conflicts have been diverse: "from the state and mining businesses they have varied between silencing and negation, then passing to the mechanisms of self-regulation that have been part of the discourse of social corporate responsibility" (De Echave *et al*., 2009, p. 18).

Such considerations are the basis of the central theme of this article: the ecological distribution which is understood as "social, spatial and temporal patterns of access to the benefits obtained from natural resources and the services provided by the environment as a system of support" (Martínez-Alier, 2004b, p. 104). This is analyzed using ecological-distributive conflicts (EDC) generated by coal exploitation, which emerge due to access to natural resources and environmental services, contamination levels and the incident of ecological risks (ibid., p. 134).

With attention to the increase of EDCs and as a response to this situation, it was necessary to trace the EDCs which have existed in the country since the 1990s (a modification of Colombian Constitutional Policy), with the goal of assessing Sustainable Development (SD) in the SCF. This approach was undertaken using the theoretical approach of Political Ecology, which is described as "the study of social conflicts surrounding access to resources and environmental services and its destruction" (Martínez-Alier, 2004b, p. 106), and where SD as defined by the Brundtland Commission: "to satisfy the needs of the present generation without compromising the capacity of future generations to satisfy their own needs" (1987, p. 24) and by Sachs (2016, p. 26): "sustainable development is a way of understanding the world as a complex interaction between economic, social, environmental and political systems." From a normative perspective, this is articulated through Sustainable Development Goals (SDGs), which are a point of departure on a global level for the analysis of sustainability.

To this effect, this article proposes analytical variables that seek to shed light on the study of coal as a non-renewable service in the ecosystem, which include: Sustainable Development, Sustainable Development Goals, Ecological Distribution and ecological-distributive conflicts (see socioeconomic and environmental conflicts).

From the concept of SD, various theories were consulted by authors who have interpreted it in a variety of ways; for example, Riechmann and Naredo (1995), Pierri (2005), Adams (1990), Serrano (1997) and Canut (2007), who note that it is a confusing concept, due to the fact that it separates the environment from development and as such is based only on economic and social objectives, leaving environmental ones to the side. Within the central theoretical support is Political Ecology, a discipline which is under construction, which makes contributions to different disciplines which converge in it. It is appropriate to say that "Political Ecology is a set of common interests that are studied from perspectives that originate in both the natural and social sciences, which gives it its interdisciplinary character" (Durand *et al.*, 2011, p. 8; Palacio, 2006).

Political Ecology opens a space for the study of EDCs, as proposed by Martínez-Alier (2004a, p. 134), which emerge from an unequal ecological distribution and consist of

disputes over contamination levels, the incidence of ecological risk and access to natural resources and environmental services. As a way to connect the above variables, the following research question was formulated: What is the takeaway from EDCs emerging from ecological distribution to sustainable development at the Sinifaná coalfield, beginning in the 1990s?

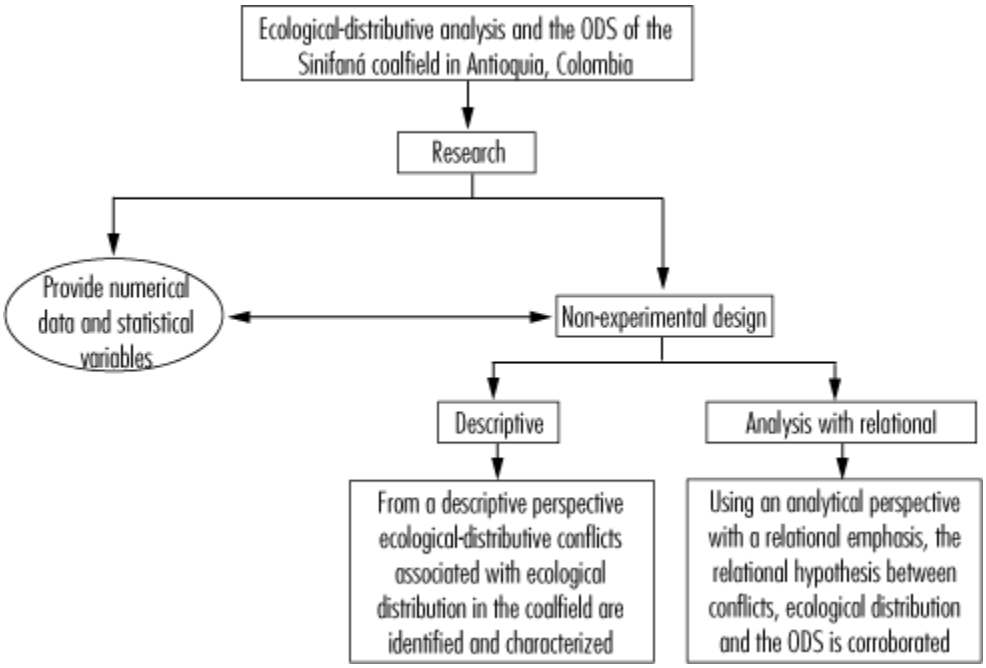
The hypothesis of this work is that the EDCs being analyzed from the perspective of ecological distribution contribute to SD in the region. To respond to the foregoing, the following objectives were formulated: to characterize the ecological distribution in the SCF based on the concept of socio-ecological system and of the UN's Millennium Ecosystem Assessment; to identify EDCs in the SCF and interpret the results of the EDCs articulated to the SDGs as a way to determine the causes of ecological distribution in the ecosystem and their incidence in the SD of the region.

The article is structured in the following way: after this introduction, the methodology and data used to undertake the research are presented. The third section develops the results, and the fourth section provides a brief discussion of these results, followed by the final conclusions.

2. METHODOLOGY AND DATA

The practical stage of the research was performed using a descriptive and analytical focus with a relational emphasis. From a descriptive perspective, EDCs were identified and characterized insofar as they are associated with ecological distribution in the SCF, while from a relational analytical perspective, the hypothesized relation between EDCs, ecological distribution, and SDGs was corroborated. Integrating these two foci allowed for an understanding of the complexity of studying EDCs, which emerge around coal exploitation and the impact of SD on the SCF (see figure 1).

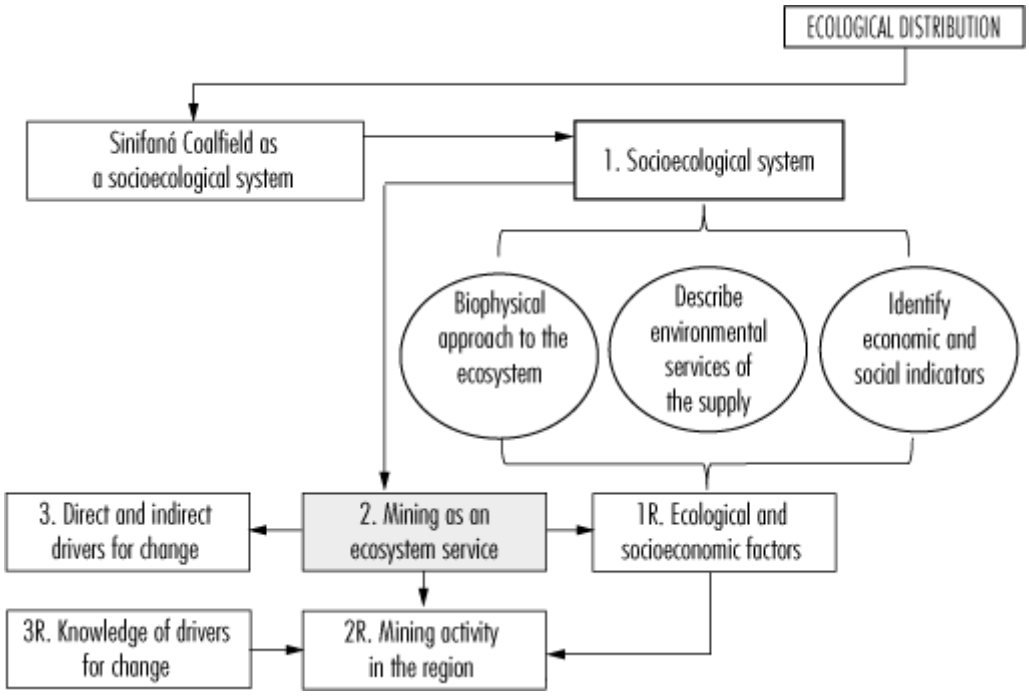
Figure 1. Methodological aspects of the research



Source: prepared by the author.

To characterize the ecological distribution, the Millennium Ecosystem Assessment (MEA) was taken as a reference (UN, 2003). This model highlights the interrelation between the various dimensions that should be taken account: ecosystem services, human well-being, and the direct and indirect driving factors of change. Furthermore, ecological distribution is referred to in terms of the socio-ecological dynamic associated with mining activities, and to the EDCs in terms of environmental benefits (see figure 2).

Figure 2. Approach for characterizing the ecological distribution in the SCF



Source: prepared by the author.

Fieldwork was performed in the Amagá municipality. From there a description of ecological distribution and EDCs was elaborated, structured on the EDCs deriving from the ecological distribution of the ecosystem, the identification of relationships between EDCs and transformations of the ecosystem and the human well-being component. Figure 3 shows the actors and institutions which made contributions to the conflicts that are presented (see Appendix, tables A1 and A2).

Figure 3. Environmental service users: actors and institutions

Governmental agents	»	Local: mayors, work inspectors, municipal councilors.
	»	Regional: Corantioquia, Secretary of Mining, SENA.
	»	National: Ingeominas.
Economic agents	»	Small-scale miners.
	»	Large-scale miners.
	»	Intermediaries.
Community or social organizations	»	ASOMICSI.
	»	National Union School.
	»	El *Amagaseño* newspaper
	»	Amagá residents.
	»	Communal Action Meetings.
Non-governmental organizations	»	Farmer and miner young households.
	»	Friends of Amagá Foundation.
	»	Bosco City.

Source: prepared by the author.

Interviews and visits were performed in the region of study (Amagá Municipality), where the environs were observed wholly and in a direct manner, and participation in local quotidian life allowed for detailed information regarding the society and its conflicts (see Appendix). The interviews were done directly with the users of the SCF (see figure 3).

The information was directed towards investigating indicators of interest related to coal exploitation, in contrast to theoretical deductions concerning the relationship between the concepts of ecological distribution and EDCs, and to identify explicit relationships generated from coal exploitation between conflicts and SD from the social, economic and environmental equilibrium. The EDCs emergent in the SCF were constructed based on the empirical evidence. In order to consolidate information, testimonials published in the press and newspapers (see Appendix, table A1) were taken into account, allowing for the identification of general tendencies in conflicts.

The sample size was made up of different governmental actors and agents, economic agents, community organizations, and non-governmental organizations (40 interviews were performed, which are described in the Appendix, table A1).

3. RESULTS

Sustainable Development and the SDGs

The origin of the SD concept can be traced to the 1970s, as Mata argues (2009, 12): "Sustainable Development emerges as a concept for the first time at the Rome Club in 1972, alluding to existing links between global economic growth and scares natural resources." Nonetheless, for authors like Pierri (2005, p. 6), "the introduction of the environmental crisis in the political arena took place at the end of the 1970s. This was prompted by a series of scientific reports, and had a decisive urgency at the UN Conference on the Human Environment which took place in Stockholm, Sweden."

Nonetheless, the UN proposed the Brundtland Commission, which was presented to the General Assembly in 1987 in a report titled "Our Common Future," in which the term SD was officially coined. This Commission established SD as a policy to be followed and its definition was taken as a framework for this article: "to satisfy the needs of the present generation without compromising the capacity of future generations to satisfy their own needs (Brundtland, 1987, p. 41). It has also been described as "a holistic approach in the sense that society must pursue economic, social and environmental goals simultaneously" (Sachs, 2016, p. 20).

Within this framework, a description the EDCs and their influence on SD in the region under study was performed, with the goal of identifying the satisfaction of human necessities and the generation of well-being in society, as reflected by access to the benefits of natural resources and environmental services in the SCF.

Based on the configuration of the 2030 Agenda, there are 17 SDGs represented by 169 goals, which were created as a way to implement actions which facilitate a path towards attaining SD in different countries. With respect to the SDGs, the UN states that "knowledge of the 17 Sustainable Development Goals (SDGs) associated with this Agenda helps to evaluate the point of departure for countries in the region [in this case the municipalities being studied] and to analyze and formulate the means with which to realize this new vision of sustainable development [analysis based on the objectives of the SDGs], which is expressed in a collective way and is reflected in the 2030 Agenda" (ONU, 2018, p. 5).

Each SDG (see figure 4) encompasses a variety of topics (goals that were used as a guide to identify conflicts), that is to say, each SDG is a world in itself and does not end with the naming of its purpose, the work of the SDGs is interdependent and each one, with its positive and negative results, has an effect on the others (INNOVE, 2016).

Figure 4. The 17 Sustainable Development Goals of the Global Development Agenda 2015-2030

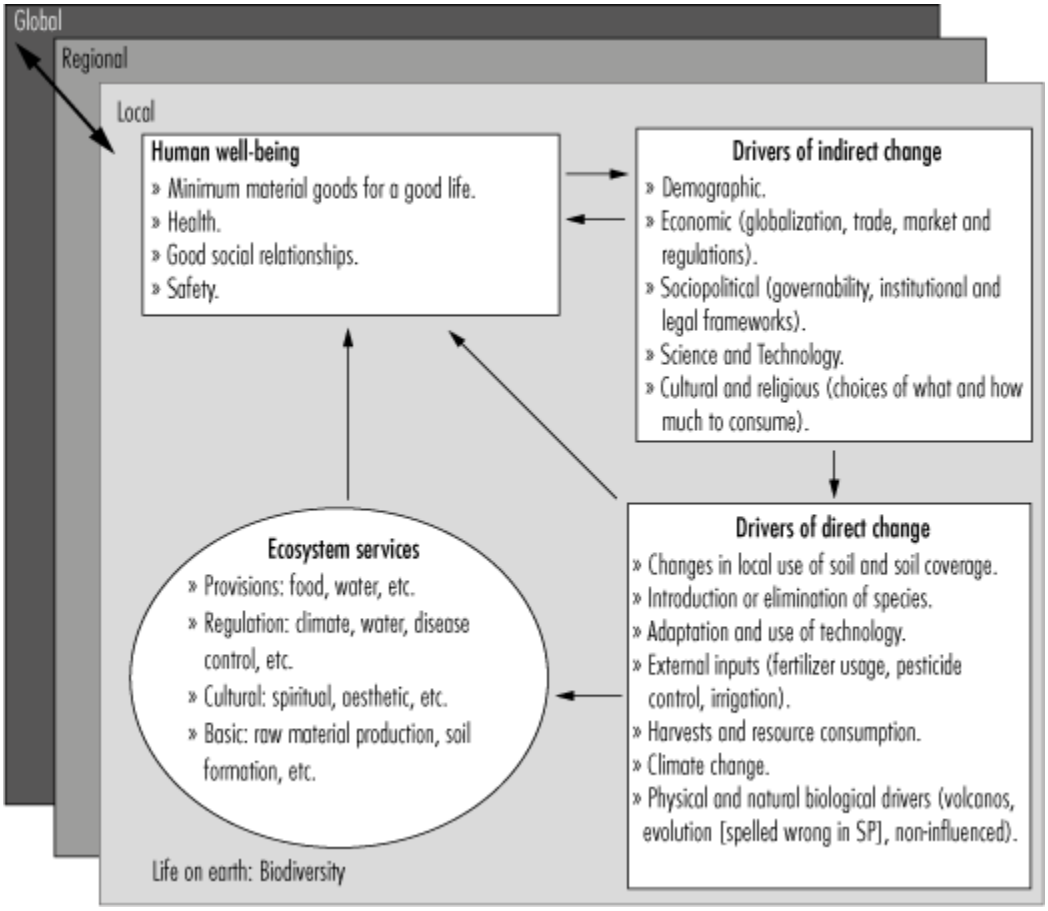
Source: UN (2018)

Using this framework, a description of the EDCs is presented and analyzed from the perspective of ecological distribution and its influence on SD in the region under study, with the goal of identifying the satisfaction of human needs and the generation of well-being in the society, based on access to the benefits of natural resources and environmental services in the SCF and the SDGs economic, social and environmental indicators. The above approach led to an analysis (using the SDG objectives) of environmental services, in this case coal, and whether transformations of the ecosystem are being generated (ecological-distributive conflicts) as a result of human actions (unequal ecological distribution), that is, if changes have been caused to the components of human well-being. Such a description within this context allowed for an analysis of the existence of more sustainable relationships between human being and nature.

The concept of ecological distribution proposed by Martínez-Alier (2004b) does not offer a detailed theoretical formulation that orients its characteristics and manifestations. Accordingly, in order to identify indicators that allowed for a characterization of the ecological distribution in the SCF, certain concepts were traced, leading to the adoption of the Millennium Ecosystem Assessment (MEA) by the United Nations. This is an "international program designed to satisfy the needs of those in charge of making decisions and obtaining information about the links between ecosystem changes and human well-being" (ONU, 2003, p. 5).

The conclusions from the MEA provide scientific value regarding the condition and tendency of global ecosystems, the services that they provide and the options available to restore, conserve and better their usage (ONU, 2003, p. 11). The analysis of indicators under the MEA provided an assessment that led to a deduction of validity for the present article, in terms of the categories that constitute it: social, economic and environmental. Furthermore, it has an explicit consideration of the spatial and temporal context (see figure 5).

Figure 5. Conceptual Framework for the Millennium Ecosystem Assessment



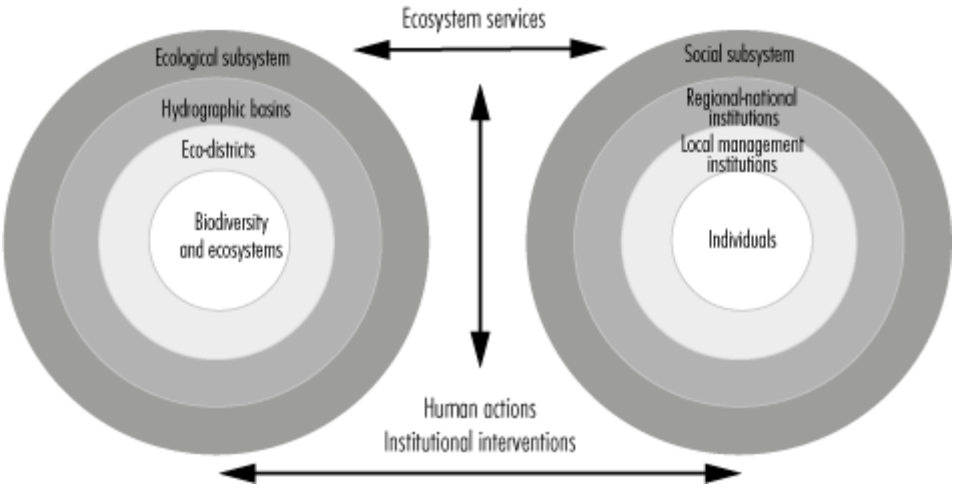
Source: Millennium Ecosystem Assessment (ONU, 2003).

As can be observed in figure 5, the list of benefits or provisions proposed by the MEA is diverse, yet, for this research an emphasis was put on provision or supply that "are the products people aquire from the ecosystem: food, combustibles, fibers, fresh water [energy resources]" (ONU, 2003, p. 13), where coal mining is taken as an ecosystem service, and as a finite and non-renewable resource.

Regarding the foregoing considerations and using the MEA, socio-ecological systems provide a framework for considering ecological and social dimensions in an integrated manner, in addition to their interrelations (Ostrom, 2009, p. 2). These systems "are characterized as complex, adaptive systems in which social and ecological components are linked […]. The natural system is related to the social system by way of the services offered by ecosystems, which contribute to the satisfaction of human needs and create well-being" (Vilardy *et al*., 2011, p. 19).

That being said, the SCF and its environs are taken as a socio-ecological system, insofar as it "integrates nature, the use made of her, society and institutions as a whole that interacts in a dynamic way in time and space" (Vilardy et al., 2011, p. 19). For knowledge of the socio-ecological system (see figure 6) and its dynamics, the relationships between the society and its environment were analyzed. In turn, this information "makes possible a reconstruction of the processes which generated environmental [economic] problems, and to identify patterns of changes and adaptive responses the system has to these changes, which facilitates the analysis of possible future answers" (Walker *et al*., 2004; Berkes *et al.*, 2003; González *et al*., 2008 cited in Vilardy and Renán (2011, p. 109)).

Figure 6. Socio-ecological System

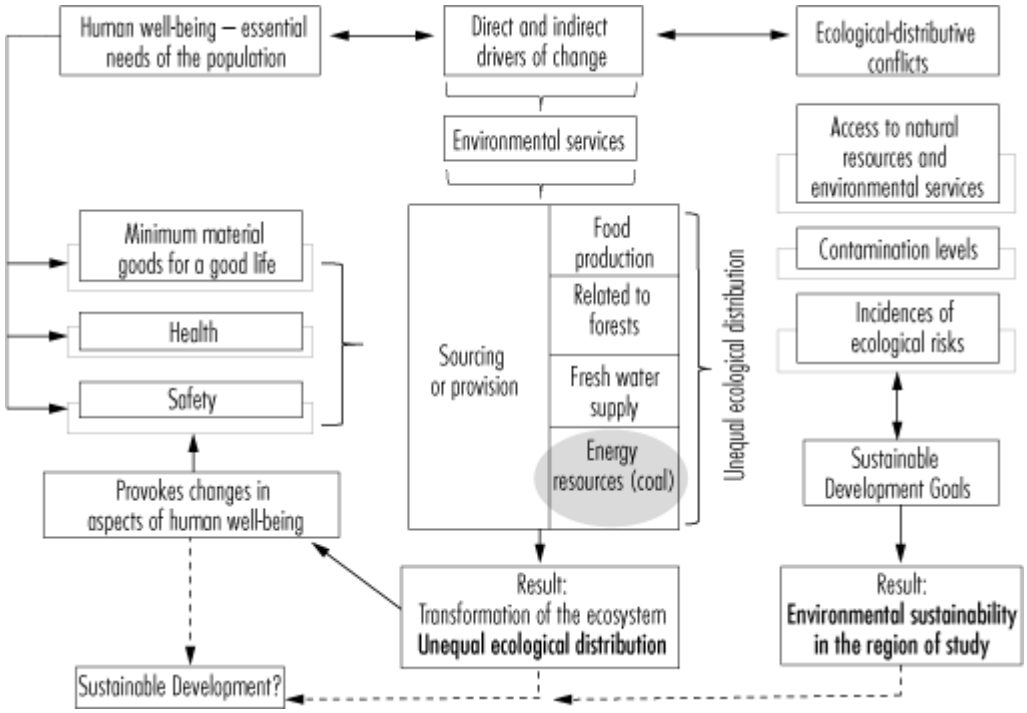


Source: Martin-López *et al*. (2009). Adapted by the author.

As a result of the analysis, all of the ecological distribution composition in the SCF was deducted, and the relationship of the social system to the natural system was defined; that is, the dynamic interaction of ecosystems with human populations and the result of human actions, that "on one hand, act to drive transformations of ecosystems [unequal ecological distribution] and, on the other hand, modifications in ecosystems provoke changes in the distinct components of human well-being [sustainable development]" (Vilardy *et al*., 2011, p. 49). These aspects of human well-being are associated with "the concept of necessities, in particular essential necessities that the poor should grant top priority" (Brundtland, 1987, p. 67). To analyze the EDCs, Martínez-Alier's definition was used: "conflicts that emerge from an unequal ecological distribution or upon the worsening of ecological distribution […]", which manifests as a common theme, as the study of social conflicts related to access to resources and environmental services, and its destruction (Martínez-Alier, 2001, p. 1). In this vein, Lamberti (2010, p. 307) argues that "these conflicts also involve assessment languages, and as such cannot be studied only from economic theory, which is why it is necessary to share interdisciplinary perspectives like Political Ecology."

Political Ecology offers a holistic look at environmental conflicts, where distinct actors have different interests, values, cultures and knowledge, and who have or can use distinct languages of assessment (Martínez-Alier, 2009, p. 8). Within this framework, Fisher *et al*., cited by Vilardy *et al*. (2011, p. 49) note that "the ecosystem services are benefits that the ecosystem provides which contribute to human well-being, which can be used actively or passively." The way that these services are used affects human well-being in a variety of ways (ONU, 2003, p. 13) and the SCF, as an ecosystem, provides a range of benefits to human well-being. According to the above approach, the relationship between the different variables can be derived (see figure 7).

Figure 7. Relationship between direct and indirect impacts, ecological-distributive conflicts and human well-being for SD



Source: prepared by the author.

Ecological distribution and environmental services in the SCF

As regards figure 7, the study was based on supplying services (coal), with an emphasis on the Amagá and Titiribí municipalities, which had 16.001 and 84.229 tons of carbon production in 2017, respectively (SIMCO, 2017). This means that coal should be considered the main economic activity in these places, in addition to causing the biggest changes based in the ecosystem (see Appendix). Coal exploitation is the most important source of economic income for the inhabitants of the coalfield, and the majority of family

income comes from this activity. It is for this reason that in recent years, the increase in coal mines being built has been directly linked to the current internal and national demand for the mineral, as well as to scarce geological knowledge (see Appendix). This coal exploitation, as an environmental service, is interwoven with other services that the ecosystem supplies.

Among other productive activities which are environmental benefits provided by the SCF, agricultural production should be highlighted (see table 1); yet, in the Amagá municipality coal production currently exceeds coffee farming, which has been the source of economic conflicts generated by the lack of land available for farming, the deterioration of soil and the recreational use of property (see Appendix). An alternative to coffee farming is banana farming, as well as avocado and orange cultivation in smaller proportions, which are found to be isolated given their little commercial importance (see table 1). Agricultural, livestock, and forest production (BIRD, 2011) as environmental services have seen decreasing participation as economic activities, given the preference of the inhabitants to work in coal exploitation (Amagá and Angelópolis), which is expressed by the mayors, who argue that the greatest economic livelihood of the municipalities' families comes from coal exploitation (see Appendix).

Table 1. Provision and supply of the coalfields

	Ecosystem services		*Area*	*Producer municipalities*
Food production	Agricultural production	Coffee	A farmed area of 6.751 hectares, representing 5.5% of the Antioquia province.	Fredonia
		Banana	The banana farming area is 2.718 hectares, representing close to 16% of the province's total area.	Fredonia supplies 70%
		Avocado	The southwest participates in the total area of the province with 29% hectares dedicated to this product.	Fredonia and Venecia
		Orange	The total farmed area is 1,979 hectares.	Venecia and Fredonia
	Livestock production	Cattle raising	This is the main livestock activity in the region, followed by pig-farming. The predominant type of exploitation in the region is meat, with 68.8%, followed by double purpose activities with 21.2%, and milk production, with 10%. This activity is more and more important in the coalfield, with the Venecia municipality being the biggest producer.	Venecia
		Pig-farming	This is the second area of livestock production in economic importance and with the most development in the region.	Amagá, Titiribí
		Aviculture	Poultry exploitation in this region has a 24% participation rate within the whole province.	Amagá, Titiribí
		Pisciculture	There are approximately 362 ponds in an area of 40,200 m2.	Fredonia
Forest related	Forest production	Forestry	Forestry production does not represent a significant usage of the land. The total forested area is 4,724 hectares, which represent 57.5% of the total planted area of the province.	Amagá and Titiribí
Fresh water provision	Water for human consumption	Fresh and potable water	Fresh and potable water supply.	Amagá, Titiribí, Fredonia, Venecia
Energy resources	Mining exploitation	Coal	Approximately 720 km2 total of the coal zone in the southwest pertains to the Sinifaná gorge coalfield	Amagá approximately 79%. Fredonia and Venecia 8.1%.

Source: BIRD Antioquia (2011) and Corantioquia (2007). Prepared by the author.

The unequal appropriation and use of environmental services generates environmental conflicts which are associated with damages to the soil's surface and to vegetation, which cause the emission of particles into the atmosphere when blasting (Najera *et al*., 2011), decreasing water quality is found in the level of negative nature and mean impact (Corantioquia, 2007), caused by practical deficiencies of illegal and informal or traditional mining, which increases constantly, according to the National Association of Industries (ANDI, 2010), which states that "in environmental terms, the biggest problem is associated with unsustainable illegal mining practices" (see Appendix).

The above originates in the discharging of acid water, and the high solid content which when dumped without being treated come to affect the fauna that lives in the water bodies where they end up (Corantioquia, 2007, p. 125). On a temporal scale, these environmental effects are taken advantage of on short, medium and long terms, depending on the type of ecosystem service. On a spatial scale, usage is local, given that such services are present in the same region. Distribution of benefits is differential and provokes changes in different aspects of human well-being.

As a way to describe ecological distribution, drivers of change were defined as the factors that alter an ecosystem; these drivers are important in determining the origin of transformations which the ecosystem is suffering. That is, it allows for establishing which are the EDCs that are causing changes to the ecosystem and are thus direct drivers that influence ecosystem processes and the indirect drivers that it uses, changing one or more direct drivers. Direct drivers, like indirect ones, generally operate synergistically (ONU, 2003, p. 22). The interaction between some of these drivers affect resource consumption levels, and the society's participation in consumption. Below, the main drivers of change present in the SCF are described, and the spatial scale on which they are developed (see table 2).

Table 2. Direct and indirect drivers of change. Type: provision or supply

Drivers	*Description*	*Space*
Demographic - population growth	The SCF population has been increasing. For the intercensal growth rate, the average population went from 1985-1993 to 1993-2005 of 0.30 to 0.38%, respectively, in the five municipalities. There is also a migratory population that moves between different mines in the region, which has meant a large concentration of the population in areas where there is more coal exploitation, in this case the Amagá municipality.	Regarding population density, the Amagá municipality has the highest density with a total of 338 inhabitants per km^2. This is followed by Angelópolis and Venecia with 95 km^2. In addition to the local scale, this is also present at a national and international level.
Economic-coal mining boom	With the tendency explicated here towards coal exploitation at an international level, this has increased for three reasons: *a)* Energy demand originating in developed countries and some developing ones; *b)* Favorability of international coal prices; *c)* Benefits of exploitation for producer countries.	International, national and local.
	Illegal mining over-exploitation.	International and all of the coalfield in Sinifaná.
	Coal prices and the coal market.	International, national and local.
Sociopolitical	Environmental legislation and international and national mining.	International and national.
	Macroeconomic policies related to natural resource exploitation.	All of national territory.
Soil degradation	Soil degradation due to factors of rainfall and inadequate soil usage.	All of the Sinifaná coalfield.
	Production systems of an extensive livestock type.	All of the Sinifaná coalfield.
Water contamination	Due to mining practices and a lack of control over illegal mining exploitation, there is an increase in water contamination that feeds the hydrographic field of Sinifaná.	In Amagá, where the largest coal exploitation is found.

Source: prepared by the author based on data from primary sources (see Appendix) and Corantioquia (2007).

Table 2 demonstrates that transformations exist that affect the ecosystem and are established as drivers: population growth, energy demand, international coal prices, environmental and mining regulations, and macroeconomic policies, among others. These drivers deduce the key indicators that are the basis of the EDCs that affect access, usage or appropriation of the benefits provided by natural resources and environmental services, adding to the changes caused by human actions that are reflected through soil degradation and water contamination.

Below, the EDCs that are derived from ecological inequality in provision and supply to the SCF are described.

Coal mining and EDCs

As a result of the analysis of provision and supply for the SCF, drivers and empirical evidence (see Appendix), the EDCs that emerge are the following:

Socioeconomic conflicts

In table 3, users classify them as having greater relevance for the problem present in the SCF (see Appendix).

Table 3. Socioeconomic and environmental type conflicts in the SCF

Medium affected	*Conflicts emergent in the coalfield*	*Environmental problems in coal mining*	*Source of impact*
Physical-biotic	– Decreasing air quality.	Fugitive particle emissions.	– Corantioquia (2006).
		Gas emissions.	– Antioquia Government (2007).
	– Decreasing water quality.	Physical-chemical contamination	
	– Changes in drainage.		
	– Poor management of residual water.		
	– Inadequate residue disposal.	Biological and organic material contamination.	
	– Poor state of existing aqueduct and sewage networks.	Obstruction of natural fields.	
	– Hydraulic contamination: water not fit for human consumption.	Contribution of sediments to currents	
	– Changes in edaphic characteristics	Changes in physical-chemical properties.	
	– Soil subsidence and instability.		
	– Soil contamination and degradation.		
	– Changes in soil usage towards subdivisions and inadequate soil usage	Subsidence.	
	– Erosive processes: soil degradation.	Loss of organic and inorganic layer.	
	– Activation of erosive processes.	Tree logging.	
	– Tree logging and loss of vegetation cover.	Reduction of vegetation cover.	
Physical-biotic	– Alteration of habitats and river ecosystems.	Habitat alteration.	
Socioeconomic	– Increased employment rate and effect on other activities.	Job creation.	– Corantioquia (2006). – Testimonies, 2012.
	– Decreased livestock and agricultural production.		
	– Increased income.	Increased income levels.	
	– Necessity of generating income for family subsistence.		
	– Coal intermediation/commercialization chain.	Commercialization of coal.	
	– Deterioration of ergonomic and health conditions.	Higher risk of accidents.	– Administrative Department of Planning-2012. – Mining Secretary testimony. – Corantioquia (2006).
	– Increased risk of accidents, due to noncompliance with safety regulations and industrial hygiene.		
	– Lack of applying mining regulations, regarding fulfillment of commitments to social security.		
	– Lack of attention by governmental entities and deficient portrayal of mining regulations to small scale miners.		
	– Lack of support regarding policy formation for vulnerable groups (children, women and seniors) on the part of the State.		
	– Deficient health, education, household and public services.	Basic needs of the population.	

Source: Testimonies (Appendix) and Corantioquia (2006, 2007), Departamento Administrativo de Planeación (2012).

A decisive conflict can be verified by the necessity to earn economic income without taking into account social and mining security in processes of exploitation, that is, when life protection moves to the background. According to testimonies by community members (see Appendix): “Unfortunately there is still not awareness in the municipality about mining security, which means that miners are being worked with so that they organize, legalize and comply with regulations on mining security”; followed by the testimony: “security conditions in the municipality’s coal mines are very diverse, and great risks persist in the exploitation of these minerals, especially for a large number of tunnels and mines that are still being informally worked in.”

In addition to the above, mining exploitation does not coincide with good practices towards the environment and life, given that tradition and ancestral forms of exploitation have a greater weight and value than any other practice (see Appendix). The environment is new for the mine owners and miners, and is a new preoccupation. Accordingly, it is not yet within their priorities, as expressed by a mine worker (see Appendix): “Our mining is not very sophisticated, but we are working with good assemblies, the mines have their lamps, so it’s not with candles anymore. There are less accidents than before. We have failed in some things, but now we are trying to do things the right way.” Added to these conflicts, miner actors (see Appendix) find the following to exist:

- Lack of mining and environmental regulations implementation, noncompliance with social security-related obligations, according to the Miner Security and Rescue Directorate: “There is a mistake in the ordinance’s interpretation. The norm prohibits women from working underground, but not outside the mine, where they can perform any type of activity. Furthermore, the ordinance says that women can only work under direction and supervision, which refers to those who eventually develop their work in the tunnels, like the engineers and security professionals.”
- Lack of mining and environmental regulations implementation, security and industrial hygiene, according to a mine worker: “The Amagá Municipality has fought to end illegal mining through monitoring and training with SENA. The problem is that it is difficult to deter underage minors, especially when they are dying from hunger. The *gurreras* are more dangerous due to poor maintenance and the lack of safeguards provided to the workers.”
- Small scale miners are not attended to by governmental entities, according to a lawyer specializing in mining: “Colombian law eliminates differences between different mining modalities, putting them under the same conditions; a new plan was determined using the figure of concession, including in Special Mining Reserve areas, and its authority was transferred to Municipalities and Provinces.”

Environmental conflicts

To complement the map of conflicts in the region, the EDCs of an environmental nature were presented (see table 3), allowing for a recognition of the consequences through

environmental damages of a greater magnitude. These conflicts impact water, air and soil to a greater degree. According to the ANDI:

In environmental matters the biggest problem is associated with illegal mining and its unsustainable practices; an evident line of questioning is the impossibility in some cases and negligence in others, of many regional environmental authorities, with respect to illegal mining, making it necessary to open the debate on structure, formation of executive boards, requirements, functions and reporting systems.

Accordingly, Corantioquia (the governmental environmental organism) and the Antioquia government identify the biggest environmental problems (see table 3) as the following: worsening air and water quality, inadequate residue disposal, change in soil characteristics, soil subsidence and instability. This is in agreement with a professor at the University of Antioquia (see Appendix), who states that: "Today miners who, despite not being formal workers and being considered illegal, are advancing the betterment of the measurement system and gas control. The slide hammer technique is impacted the most by the use of combustibles, but is the most competitive."

On a spatial scale, where changes that originate in the ecosystem also originate on a local scale, they have impacts on environmental services (described previously as agricultural and livestock production, forest loss, and availability of water fit for human consumption), according to a community member (see Appendix): "All of life revolves around mining. We have no other destination than to go to the little hole (the mine), in agriculture there is nothing to do, to bring food home […]."

EDCs and SDGs

After having analyzed the EDCs deriving from unequal ecological distribution, the goals and global indicators of SDGs were corroborated, and it was determined that the SDGs (1, 2, 3, 4, 5, 6, 8, 10, 11, 12, 13, 15) would articulate with the conflicts. In table 3 it is demonstrated that on the basis of the conflicts generated by mining exploitation, the SDGs are not complied with. In particular, these conflicts include:

- Lack of mining and environmental regulations implementation, as well as that of security and industrial hygiene. This conflict makes it impossible to fulfill SDG 1 "End Poverty" and 8 "Decent work and economic growth," given that it does not guarantee the coverage of social protection for the poor and vulnerable, nor does it guarantee access to economic resources and basic services for the population of the SCF, according to goal 8.8. "To protect labor rights and promote a safe work environment without risks for all workers, including migrant workers, especially women migrants and people with precarious jobs" (see table 4).
- Small scale miners are not accompanied by governmental entities, a conflict which prevents compliance with SDG 8 "Decent work and economic growth," since the State does not guarantee a safe and protected work environment for the region's miners (see table 4). According to goal 8.5, "From now until 2030, to achieve full

and productive employment and decent work for all women and men, including young people and people with disabilities, in addition to equal pay for work of equal value."

- The necessity to generate income for family subsistence, a conflict which prevents fulfillment of SDG 10 "Reducing inequalities," and which establishes that there is an income increase in the poorest population of the region of study (see table 4). According to goal 10.2, "From now until 2030, to enhance and promote social, economic and political inclusion of all people, independently of age, sex, disability, race, ethnicity, origin, religion, economic situation or other condition."
- Environmental problems include decreasing air and water quality, inadequate residue disposal, changes in soil characteristics, soil subsidence and instability, which prevents fulfillment of SDG 3 "Health and well-being" which establishes that contamination of water, air and soil should be avoided. SDG 6 "Clean water and sanitation" presents an efficient use of water resources in all sectors, and SDG 15 "Life of Land Ecosystems," which is directed towards conservation and the reestablishing and use of land ecosystems (see table 4).

Table 4. Ecological-distributive conflicts and the SDGs

SDG	Issues	Conflicts	Sources
1. Poverty 8. Decent work and economic growth	– Coverage of social protection systems for the poor and vulnerable. – Guarantee access to economic resources and to basic services.	– The SCF population has been increasing. The intercensal average rate of population growth between 1985-1993 and 1993-2005 went from 0.30 to 0.38% respectively in five municipalities (last census 2005), and a total population of 44,481 inhabitants (Antioquia Statistical Yearbook, 2016). There is also a migratory population that moves between different mines in the region, which has meant a large concentration of the population in areas where there is more coal exploitation, in this case the Amagá and Titiribí municipalities. – Lack of mining regulations implementation, in terms of compliance to obligations related to social security (health and pensions). – Mining is the main source of income for family subsistence.	– Antioquia Statistical Yearbook (2016). – DANE, Census (2005). Testimonies -Appendix 1, table A1.
2. Zero hunger	– Food security. – Resilient agricultural practices. – Investment which increases agricultural production capacity.	– Security in the Sinifaná coalfield is affected by changes produced in environmental services supply, which then affect provisions of food and other goods for the region's inhabitants. In the region there is more use of coal exploitation, a service which tangles with agricultural and livestock production which has been decreasing.	
3. Health and well-being	– End epidemics, including AIDS, tuberculosis, malaria and neglected tropical diseases. – Prevention and treatment for addictive substance abuse. – Universal sanitation coverage. – Air, water and soil contamination.	– Miners that work in illegal and informal mining, which form the majority, do not have a health membership. This indicates that they are working at the risk of acquiring illnesses or lesions and without adequate health insurance. This problem is closely related to supply services, insofar as access to coal exploitation. – There is a decrease in air quality, emerging due to toxic gasses issued by coal exploitation in the region, and which cause many miners, in addition to people close to the mines, respiratory illnesses which decrease their quality of life. – Within mining culture there are problems of alcoholism, drug addiction, prostitution, single mothers, poverty, unemployment, environmental education, gambling, and scarce recreation. – Soil and subsoil: changes in soil characteristics, soil subsidence and instability, contamination and degradation of soil, change in soil use towards subdivisions and inappropriate usage of soil and erosive processes: soil degradation.	– http://www.corponor.gov.co – Santander Northern Regional Autonomous Corporation. – http://www.upme.gov.co/guia_ambiental/carbon/ - Energy Mining Planning Unit. – Corantioquia - Autonomous Corporation of Antioquia.
5. Gender equality	– End all forms of discrimination. – Eliminate all forms of violence against women and girls. – Promote shared responsibility in the household and family. – Full and effective participation of women	– Insufficient State formulation of mining regulations (Mining Code), in which vulnerable groups are not included (women, children, seniors).	
6. Clean water and sanitation	– Universal and equitable access to potable water and sanitation and hygiene services. – Water contamination by dumping and disposal of materials and dangerous chemical products. – Efficient usage of water resources in all sectors.	– Currently there is high water contamination, generated primarily by coal exploitation, which discharges toxic waste into water sources, causing water contamination in rivers. Accordingly, quality of life decreases in terms of access to water as a source of life. Affecting other environmental services like water supply, which affect material well-being and the health of people living in the area. – Water contamination causes: decreasing water quality; drainage changes; inadequate residue disposal; poor state of existing aqueduct and drainage networks. Water contamination: water not fit for human consumption. – This unequal appropriation and use of environmental services generates environmental conflicts associated with damage to the soil surface and vegetation, as well as generating particle emissions to the atmosphere when blasting. Decreasing water quality is found to be in the level of negative nature and medium impact. It is common for mining Bocaminas are located at the lowest points of the terrain, with the goal of maximizing coverage by excavations, thus making sterile dumps located in low zones where natural draining or water channels are usually located, obstructing them and constituting potential risks for growing avenues in obstructed channels, and the permanent source of sediment brought to water channels with all of the environmental damages that this implies. Accordingly, for environmental degradation present in the region, two fundamental problems are highlighted: those related to solid and water, which cause transformations and important changes within the ecosystem.	– Najera (2011). – Corantioquia (2017).

SDG	Issues	Conflicts	Sources
4. Quality education 8. Decent work and economic growth	– Economic productivity, efficient resource production and consumption. – Employability of youth. – Forced labor. – Labor rights. – Safe and protected work environment. – Education for Sustainable Development and adoption of sustainable lifestyles	– The Mining Code does not differentiate between large-scale and small-scale mining, a lack of differentiation which can hide or exacerbate environmental problems. This unequal access to services supplies by the ecosystem raises the well-being of small segments of the population, in this case the large-scale mining, which are those who have the capital important to comply with regulations established by the Colombian state, leaving to one side a considerable percentage of miners, whose bad practices are increasing environmental problems with the excessive use of coal as an ecosystem service is jeopardizing its future availability. – The ecosystem presents various environmental problems, due to coal exploitation in an intensive form and without any compliance to environmental and mining regulations (Testimonies, 2018). On one hand, certified mining businesses still do not have a consolidated Environmental Management Plan, and only fulfill the minimum requirements. On the other hand, increasing uncertified mining does not follow the minimum environmental regulations required by the State, like the Environment Management Plan (Mining Code) to solicit the mining certification (fieldwork, 2012). – Lack of implementation of mining regulations on the part of small-scale mining, regarding the fulfillment of obligations related to social security. – Increase risk of accidents, due to nonfulfillment of security and industrial hygiene regulation, on the part of informal and illegal mines. – Lack of attention to small-scale mining by governmental entities, and deficient formulation of mining regulations, which do not include small-scale mining. – Lack of mining regulation implementation, in terms of security and industrial hygiene.	– Mining Code. – Testimonies (2018), Appendix 1, table A1.
10. Reducing inequalities	– Growth of income for the poorest 40% of the population. – Social, economic and political inclusion for all people. – Eliminating discriminatory laws, policies and practices.	– As a social organization, the coalfield has seen structural changes in recent decades. This is because the region comes with an ancestral structure of coal exploitation, as a main source of income, and all conflicts that have been exacerbated have caused changes in the family structure. Family incomes are based on the head of the household, now women and children are prepared for mining because they need economic resources in order to sustain their families. Mining, with its risks, may leave them without a father, with an invalid father, ageing and without social security (fieldwork, 2012); accordingly, the disintegration of the nuclear family is increasing.	Testimonies (2018), Appendix 1, table A1.
11. Sustainable cities and communities	– Access to housing, basic services and adequate transportation services.	– Deficient services for health, education, housing and public services.	Testimonies (2018), Appendix 1. Antioquia Statistical Yearbook (2016).
12. Responsible production and consumption	– Sustainable management and efficient use of natural resources. – Sustainable business practices and sustainability reports. – Broader pertinent information and knowledge for sustainable development.	– Mineral extraction is primarily performed manually and in many mines in an artisanal way, only 13% of mining units employ resources for technification and better their productive processes. Few coal exploitation mining units are recognized with appropriate technological development. This indicates that each mining business makes the necessary investments for operation, which allows them to work under adequate conditions. Accordingly, one can conclude that mining exploitation is still performed primarily in empirical form, traditional mining (workers and worker descendents who learn the trade by necessity and proximity to mining developments), in the case of informal mining. For formal mining, efforts are made to make the necessary investments for mine operation. Thus, the lack of technology can increase degradation of the environmental services supplied by the ecosystem.	Testimonies (2018), Appendix 1.
13. Climate action	– Resilience and the capacity for adaptation to risks related to the climate and natural disasters.	– Environmental problems generated by mining on a global scale influence climate change, which may manifest in a period of one or more decades, having effects on global climate change, the ozone layer, loss of biodiversity, and increasing carbon dioxide concentrations, among others.	
15. Land ecosystem lifes	– Conservation, restoration and sustainable use of forests, wetlands, mountains and arid zones, degraded forests, forestation and reforestation.	– Water resources are insufficient, shows deficiencies in terms of quality and quantity, such as: disposal of domestic residual water, deforestation in productive zones and natural forests, invasion of flood plains in rivers and gorges, sedimentation in channels and chloride discharge, sulfates, nitrates, water sources, poor residual water management, caused by mining practices. Vegetation: activating erosive processes, tree logging and the loss of vegetation, habitat alteration and marine ecosystems.	(Antioquia Government, 2011b, p. 34). Corantioquia - Autonomous Corporation of Antioquia.

Source: prepared by the author based on ONU.

In summary, the EDCs generated by coal exploitation do not allow for fulfillment of the central SDGs, which are SDG 1 “Ending poverty” in the case of socioeconomic conflicts, and SDG 13 “Climate action,” due to environmental conflicts.

4. DISCUSSION

Ecological distribution as an object of study

Table 5 demonstrates changes and transformations (unequal ecological distribution) that are present in the ecosystem, where coal exploitation in the coalfield is an environmental service easily accessible to inhabitants, and which is currently the primary economic activity generating income for family subsistence. However, security in the SCF is affected by the changes that are caused by other environmental supply services such as food. Additionally, mining activity is performed with the risk of developing illnesses or lesions and without having adequate health insurance.

Table 5. Provision services that supply the SCF and its connections to human well-being

Global / Regional / Local	Human well-being	Indirect drivers of change	Direct drivers of change	Ecosystem services “Sinifaná coalfield”
Local	Minimum material goods for a good life. Coal exploitation in the Sinifaná coalfield has been present for around 200 years, and is an ancestral economic activity which the inhabitants of the area carry in their veins. Accordingly, it is an environmental service which is easily accessible for the coalfield’s inhabitants. It is currently the main source of income for family subsistence. In terms of other provision services, like agricultural and livestock production, have been decreasing, which causes a risk for access to basic goods for a good life, in this case food. Health. Social Security System Affiliation: miners that work in illegal or informal mining, which form the majority, have no health affiliation. This indicates that they are working at risk of illnesses or lesions, with no adequate health insurance. This issue is closely related to provision services, in terms of access to coal exploitation. Water quality: Currently there is high water contamination, generated mostly by coal exploitation, that dump toxic waste in water sources, causing contamination of river water. Accordingly, quality of life decreases, as water is a source of life. Air quality: air quality is worsening, as a consequence of toxic gasses issued by coal exploitation in the region, this being caused both by mining and by people close to mines, respiratory illnesses diminish quality of life. Safety. Safety at the Sinifaná coalfield is affected by changes in provisional environmental services, since food supplies and other goods used by the region´s inhabitants are affected. Similarly with the increased use in coal exploitation, a service which clashes with agricultural and livestock production, which has been decreasing. Other environmental services are also affected, like the water supply, which then affects material and health well-being of people living in the area. Technology: Mineral extraction is mostly done manually, and in many mines with artisanal methods, with only 13% of mining units employ resources for technification and better their productive processes. Few coal exploitation mining units are recognized with appropriate technological development. This indicates that each mining business makes the necessary investments for operation, which allows them to work under adequate conditions. Accordingly, one can conclude that mining exploitation is still performed primarily in empirical form, traditional mining (workers and worker descendants who learn the trade by necessity and proximity to mining developments), in the case of informal mining. For formal mining, efforts are made to make the necessary investments for mine operation. Social organization: As a form of social organization, the coalfield has seen structural changes in recent decades. This is because the region comeswith an ancestral structure of coal exploitation, as a main source of income, and all conflicts that have been exacerbated have caused changes in the family structure. Family incomes are based on the head of the household, now women and children are prepared for mining because they need economic resources in order to sustain their families. Mining, with its risks, may leave them without a father, with an invalid father, ageing and without social security (fieldwork, 2012); accordingly, the disintegration of the nuclear family is increasing. Institutions: In terms of environmental and mining legislation and environmental and mining management, benefits to human well-being are not automatic, nor are they distributed equally. The Mining Code does not differentiate between large-scale and small-scale mining, a lack of differentiation which can hide or exacerbate environmental problems. This unequal access to services supplies by the ecosystem raises the well-being of small segments of the population, in this case the large-scale mining, which are those who have the capital important to comply with regulations established by the Colombian state, leaving to one side a considerable percentage of miners, whose bad practices are increasing environmental problems with the excessive use of coal as an ecosystem service is jeopardizing its future availability.	→ 1. Demographic – population growth: The SCF population has been increasing. For the intercensal growth rate, the average population went from 1985-1993 to 1993-2005 of 0.30 to 0.38%, respectively, in the five municipalities. There is also a migratory population that moves between different mines in the region, which has meant a large concentration of the population in areas where there is more coal exploitation, in this case the Amagá municipality. ← 2. Economic - coal mining boom: With the tendency explicated here towards coal exploitation at an international level, this has increased for three reasons: –Energy demand originating in developed countries and some developing ones. –Favorability of international coal prices. –Benefits of exploitation for producer countries. In addition to other factors: –Illegal mining over-exploitation. –Coal prices and the coal market. 3.Sociopolitical: International and national environmental and mining legislation. –Macroeconomic policies related to natural resource exploitation.	↓ 1.Soil and subsoil: –Changes in soil characteristics. –Soil subsidence and instability. –Contamination and degradation of soil. –Changes in soil use towards subdivisions and inappropriate usage of soil. –Erosive processes: soil degradation. ← 2. Water: –Decreasing water quality. –Drainage changes. –Mishandling of residual water. –Inadequate residue disposal. –Poor state of existing aqueduct and drainage networks. –Water contamination: water not fit for human consumption.	↓ Provision and supply: Food production, related to forests, supply of fresh water and energy resources – coal. Agricultural, livestock and forest production as environmental services have decreased in production and participation as an economic activity, given inhabitants’ preference to work in coal exploitation, especially in the Amagá and Angelópolis municipalities, where mayors express that the large part of family economies are sustained by coal exploitation for the people who live in those municipalities.

Source: prepared by the author based on UN (2003).

As a consequence, environmental services provided by the ecosystem, and what people expect from it, were elaborated on. This made it possible to highlight coal exploitation as the principal economic activity among the region's inhabitants. Similarly, it reveals the way human well-being has multiple components, including the minimum material goods required for a good life, health, security, technology, social organization and institutions. Human intervention in the ecosystem can affect benefits to society, and are given through indirect drivers, which in the case of the coalfield are caused by demographic growth, the coal mining boom –the overexploitation of illegal and informal mining—and Colombian environmental and mining legislation.

EDCs as a central dilemma

From a holistic perspective, EDCs were identified as unleashing social and economic conflicts which go against SD in the region. This makes possible the deduction that within the reach of EDCs, two major limitations exist: small scale mining –informal or traditional—, which is done based on coal exploitation without any fulfillment of technical and environmental requirements; and coal exploitation as an economic activity upheld by the inhabitants with a strong tradition and set of customs, and which is considered the main source of income.

Seen from different interests, or assessment languages, it is difficult for miners to stop working with coal, given that their main concern is survival and the generation of economic resources. Accordingly, it becomes difficult for miners to resolve these conflicts. Until these differences are resolved, then, new conflicts based on bad mining practices will continue to arise, and the well-being of future generations will be damaged as a consequence.

5. CONCLUSIONS

- Based on environmental services, transformations are being generated in the ecosystem, as a result of human actions (unequal ecological distribution). These changes derived from EDCs present in the region are for the most part caused by mining regulations, in addition to the necessity of miners to obtain better economic income.
- The biggest conflict in the region of study is associated with environmental unsustainability, deriving from illegal and informal mining practices, which has caused a multitude of EDCs, in turn impacting the well-being of people living in the SCF. Additionally, this conflict is continually exacerbated due to little control and monitoring of mining practices in the region by local and national authorities.
- Quality of life for the region's inhabitants is detrimental to human well-being, as a result of EDCs caused by coal exploitation, and evidenced by the lack of SDG fulfillment. This points to the conclusion that SD in the region is decreasing, due to the fact that the goals agreed upon in the SDG Agenda 2030 are not met.

- Human well-being in the SCF can increase by way of sustainable interactions between humans and the ecosystem, that is, relationships backed by efficient management instruments and control over mining and environmental regulations, regulations and coherent norms for coal mining activity and the interests of society, and by taking into account small and medium scale miners in the region.
- Human interactions can be achieved using participatory, flexible and transparent processes between people who use the ecosystem's services, which contribute to the strengthening of economic, social and ecological security for the region. In other words, "security […], that has a minimum level of supply […] necessary to guarantee a sustainable flow of services provided by the ecosystem" (ONU, 2003, p. 11). All of this should be steered towards the achievement of a SD which aims to construct a region with better economic progress, where extreme poverty is decreased or eliminated, where there is social trust in mining policies that are oriented towards the community's well-being, and where the environment is protected from bad mining practices.

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APPENDIX

Table A1. Testimonies from actors related to the SCF

Type of actor	Actors	Testimonies	Conflicts							
			1	2	3	4	5	6	7	8
Governmental agents	Antioquia Mining Secretary	The El Desespero mine, where the accident occurred, had an exploration certification and was not authorized to exploit it. Furthermore, the exact area where the emergency happened was not considered by the permit in question. The standard conditioning needs to be respected, we should be subject to legality, and more so for an activity with so much risk which shows what life is. The right to life is more important than economic and social problems that could arise from the possible mine closures. According to studies and descriptions by the Secretary of Mining and National Mining Agency, in the Sinifaná coalfield around 120 mining units have been identified which practice their activities without the protection of a mining certification.	X							
	Mayor of Angelópolis	There are 105 illegal mines, and on some occasions, I have tried to close some given the risk they represent for their workers, but this would imply a larger issue since the majority of family economies in the municipality depend on work in these mines. The municipality is not in a condition to generate other income.		X	X	X				
	Mayor of Amagá	Closing illegal mines is inconvenient for a large quantity of families that live by coal extraction, and the closing of these mines could unleash a problem of a public and social order.			X					
	Regional Bureau of Labor	A change is needed urgently in the region's culture, which is permeated by armed groups and phenomena like drug addiction and delinquency—elements which deepen inequality.					X			
	Former deputy of Antioquia Departmental Assembly	The problem lies in the intermediation chain that exerts a great exploitation on this small and medium-scale mining, and which prevents them from reaching modern and safer mediums for exploitation.						X		
	Former deputy of Amagá Assembly	The amount of problems that Amagá has in terms of health, education, roads, infrastructure, aqueducts and …. Additionally, low coal prices for small-scale mining make it key that regulations for coal prices be established, intermediation is eliminated, such that small-scale mines can sell its coal at international prices. The government has closed off the possibility of opening mining formalization processes, since the mining code does not recognize small and medium-scale mining.					X	X		
	Former mayor of Amagá	Exploitation of coal is the main activity in the municipality. We are working so the Government supports productive projects, with local entrepreneurs and owners of legal mines, so that they employ these people—but the solution is on the medium term. Accordingly, it is necessary that the municipality's economic activity be modified and it be proposed that it be converted to the agricultural sector.				X				
	National Directorate of Mining Safety and Rescue	There is a mistake in the interpretation of the regulations. These women have nothing to fear, the rules prohibit women from working below ground, but not outside the mine, where they can perform any type of work. Additionally, the regulations say that women can only work under direction and supervision, which means that eventually they develop their work within the tunnels, like engineers and safety professionals.							X	

Type of actor	Actors	Testimonies	Conflicts							
			1	2	3	4	5	6	7	8
Economic agents	Mine owners	People are very aware that a tragedy can happen in any mine, and it is the first time that this region has had an accident of that magnitude in such a small mine.	X	X						
		Even though one may have worked and fought here for years, if someone knows the terrain, where to enter, where to work, they can be taken out at any moment. They don't let us work.								
	Mine workers	I have worked in the tunnels, but I prefer to be outside since there are fewer risks. Inside, you don't know if you will come out again. I started crying when the functionary of the Mining Ministry mentioned those regulations to me, because—what can I do? If not here, where can I work?							X	
		This land is made for mining, and here most people grow up with the wish to have their own mine and work it.			X					
		At ten years old, I began to work in a hole by the side of the highway, near Angelópolis, since I was so small I fit into the holes that the bosses dug and from there I would get coal.			X					
		The Amagá municipality has fought to end illegal mining using monitoring and training from the SENA. The problem is that it is difficult to deter underage minors, especially when people are dying of hunger. The guineras or capotera mines are the most dangerous ones because of the lack of maintenance, and the lack of guarantees they give their workers.		X	X				X	
		Our mining is not very sophisticated, but we are working with good assembly, the mines have their lamps, it's not with candles anymore. There are less accidents than before. We're failed in some things, but now we're trying to do things right. It's strange that the large legal companies are those that have caused the most deaths in the area, with small-scale mining having a much lower number.								
		The access roads to the fronts of work are inadequate and risky, because when high tension cables are passed through, all the personnel touch those cables with their backs because in some parts the tunnels are only a meter and a half tall.	X	X						
	National Industrial Association (Spanish ANDI)	In environmental matters, the biggest problem is associated with the unsustainable practices of illegal mining; an evident question is impossibility in some cases and negligence in others, of many regional environmental authorities, with respect to illegal mining, which makes it necessary to open the debate on structure, forming governing boards, obligations, functions and reporting systems.	X	X						
	Lawyer with mining specialization	Colombian law eliminates differences between different mining modalities, putting them under the same conditions; a new plan was determined using the figure of concession, including in Special Mining Reserve areas, and its authority was transferred to Municipalities and Provinces. In these cases, legal certifications are granted to large companies and traditional miners are often forced to work illegally; in some cases, a legitimate process to undertake the resettlement and compensation of the population and in doing so allow mining at a broad scale. Nonetheless, for others the government intervenes or even the public force to make the rights of private business valid. The political and economic transformations lived in the past eight years changed aspects of the mining business in Colombia, which moving forward, will receive priority for the big capitals.								X
	Professor at the University of Antioquia – Medellín campus	Today, the mines, despite not being formal and being considered illegal, are advancing the bettering of the measurement system and gas control. The slide hammer technique is impacted the most by the use of combustibles, but is the most competitive. Contamination can be mitigated with compressor filters.		X						
		Insecurity in mines is due to informality.		X						
	Mining safety and occupational health expert	I'm taking the opportunity to call all of the mining authorities so that we not only have control over Industrial Safety in the small and medium-scale mines, but in the area´s large mines which have in recent months seen tragedies and fires on a large scale	X	X						

Type of actor	Actors	Testimonies	Conflicts							
			1	2	3	4	5	6	7	8
Social community organizations	Sinifaná Coalfield Miner Association	It is an activity which is pursued by the government, which it classifies as illegal and denies the opportunity to be formalized. We don´t work at the margins of the law, we ask for modifications of the Mining Law in order to prioritize the rights of small-scale miners, with the goal of access to certifications and respecting their labor, and providing the hectares necessary to continue this work in a dignified manner.								X
		Small-scale mining is not the problem but the solution, since it generates more than 5,000 jobs directly in the region—but it is alone, and doesn´t have help. The Mining Code establishes a period of two years for informal mines to be legalized and normalized, otherwise they will be closed. Help has always gone to the big businesses, but the small-scale miners have never been attended to.						X		X
		As a priority, the government should regulate the price of coal. Well, it´s the only way to increase income for small-scale miners, who are obligated to sell coal at the low prices of intermediary traders, who then sell it at double the price in the Medellín markets and other Colombian cities. With higher incomes for small-scale miners, they could improve technology and security in their mines, guarantee loans and social security for their works, and pay royalties to the government.								
		What the government says isn´t true—of the 150 applications for legalization of mines in the southwest, none were approved. We need to streamline these formalization processes, since for the miners it has always been more profitable to open a hole and then wait for the state to close it. The authorities should differentiate between informal mining and illegal mining: illegality is not the lack of a mining certification or not having an operation contract, it is was is available to the groups at the margins of the law, and if they close the mines they take away our mode of subsistence.								X
		Informal miners respond to calls for training made by the government, and this is somewhat useful. But it is insufficient. An effective contribution would be to provide them with permits for exploitation or concession contracts; giving their history validity, since there are people who have been mining informally for 20 or 30 years. And also to give them financial support and provide technical instruments like cars, winches, fans, three-phase power, gas meters, so that they can improve safety in the mines and continue to provide jobs with social benefits.								X
		Last year, we presented proposals for legalizing mines that comply with regulations; we haven't had any viable responses, and because of this we are still working on fulfilling the requirements. We hope that this year it will be possible for us to continue pushing these processes. We are also hoping for better prices.								X
	Sinifaná Coalfield Miner Association	DFor years, the state has advanced a plan for regularization which has ended in giving land, mines and concessions to multimillionaires who aren´t from the region. The illiterate person continues to be illegal in this country. Big companies abstain from buying from them, but do it with intermediaries, who end up with the majority of the profit. "Who is more illegal, the small-scale miner or the big businessman who buys from the illegal intermediaries who buy from us? We are the ones making them rich."						X		X
	Sociologist from the Pontificia Bolivariana University	Ending traditional mining practices would not only exclude small businesses from the market, but would cause increasing levels of unemployment in the region, since big industry isn´t capable of integrating the 6,000 artisanal miners who currently dedicate themselves to these activities. While the authorities do not exercise control or promote a budgeted allocation focused on sustainability of small-scale mining, incentivizing formalization, and thereby diminishing labor and environmental risks, small producers must remain illegal.	X	X						X
	300 miners – miner march in Amagá 2010	We can fall, we can be hurt, we can die and even then we still need work.			X					

Type of actor	Actors	Testimonies	Conflicts							
			1	2	3	4	5	6	7	8
Social community organizations	Community members	It´s impossible—all of life revolves around mining. We have no other destination than to go to the little hole (the mine), in agriculture there is nothing to do, to bring food home. Like they say in the municipality, some die so that others can live and profit.			X					
		Whatever they say, it´s necessary to keep working in this because there are no other jobs around here.				X				
		Unfortunately there is still no awareness on the topic of mine safety, which is why we are working with the miners so that they organize, legalize and comply with mining safety regulations.	X	X						
		In Colombia, three people die each day from work accidents, and mining contributes the majority of these, which is why the OIT has demanded special policies for this sector. The industrial security model in Colombia has many faults. The first is that the ARP, in charge of giving technical training to mining companies, are not providing this since they don´t know about this activity. The state, which should be monitoring by way of the mining ministry and social protection, is not doing this adequately. And companies do not have effective and coherent programs, given the risks of the job.	X	X						
		Security conditions in coal mines in the Amagá municipality are diverse, and major risks persist in the exploitation of these minerals, especially for a large number of tunnels and mines that are still being worked informally.	X	X						
		Traditional mining has been abandoned by the state, and has not had help in moving forward. While large businesses, which are not even miners, ask for help and receive it.								
		In the past year, state entities have increased their backing, like the Secretary of Mining, Ingeominas, and the Ministry of Social Protection, though there is still a lack of more investment and backing of small-scale miners, which is where the bigger difficulties arise.								X
	Former trade union officer	Ingeominas should push forward disaster prevention programs, offer evacuation plans in the mines, loan technical assistance on a regular basis, and not limit themselves to the sad role of removing the dead.								X
	Former trade union officer	What businesses are interested in is production, no matter how, and without the monitoring of the Labor Ministry, which is inoperative here. Further, miners do not complain nor do they sue, out of fear of being fired, since coal is the only source of work in the region. They cannot even mention the word union because they are kicked out. And those that we have characterized as union leaders are banned, not given work in any mine, nor to our children or siblings.			X					
	CUT - Antioquia	In Colombia, there is a general tendency on the part of business owners and the Professional Risk Insurers to place the responsibility for accidents on workers. They do not recognize the ineffectiveness of prevention plans that are, for many businesses, primarily mere formalities. The work accident registry only covers 37% of the mining population in the Sinifaná coalfield, which is the portion included in the professional risk system. We do not have information about the remaining 63%, because they work in mines that are not legally registered.	X	X						X
	Number of responses:		10	13	8	3	2	4	3	11

Source: National Union School (July 16, 2010); RCN La Radio (March 15, 2012); Henao, A. (2012); Montoya, J. (June 19, 2010); Antioquia Secretary of Mining (2012); Caracol Radio (June 17, 2011).

Table A2. Testimonies from actors related to the SCF (description of conflicts)

Conflict number	*Conflict*	*Number of responses*
1	Lack of adherence to mining and environmental regulations, in terms of non-compliance with obligations related to social security.	10
2	Lack of adherence to mining and environmental regulations, in terms of safety and industrial hygiene.	13
3	Need to generate income for family subsistence.	8
4	Decrease in livestock and agriculture production.	3
5	Deficient health services, education, housing and public services.	2
6	Intermediation chain/ coal commercialization.	4
7	Deficient formulation of mining regulations, in that they do not include vulnerable groups (women, children, the elderly).	3
8	Lack of backing on small-scale mining by governmental entities.	11

Source: prepared by the author.