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Sustainable development and environmental challenges in Cameroon's mining sector: A review

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Abstract
Cameroon has a strong geological potential for a number of mineral resources that, if well managed, could support economic growth. The country contains potentially large deposits of iron ore, gold, bauxite, diamond, limestone, nickel, and gemstones, and indices of other numerous minerals and precious metals. Despite its geological wealth, mining has never played a major role in Cameroon's economic development. A study on the state of sustainable development and environmental challenges in the Cameroon mining sector permits the identification of key points for improvement in order to position the country towards achieving a sustainable mining industry in the future. This paper reviews the mining potential, stakeholder participation, legislation, and mining policy in Cameroon mining industry. The methodology involves a single case study focused on the review of sustainable development in the Cameroon mining industry up to date. It includes scientific studies, and reports of ministries and support organizations, national laws, and regulations related to the area of study. Also the corporate sustainability reports of mining companies and mining stakeholders are analyzed. This research work covers the latest developments in terms of the institutional and regulatory frameworks for mining and the environment in the country, history of mining in Cameroon, and evolution and issues of the Environmental and Social Impact Assessment (ESIA) system in the mining sector until 2016. The work concludes with an identification of the current challenges of implementing sustainable development in mining as well as future directions that research works on this area should take.

Keywords: *Mineral Resources, Economic Development, Mining Policy, Environmental and Social Impact Assessment, Sustainable Development.*

1. Introduction

The UN conference on the human environment held in Stockholm in 1972, the UN conference on the environment and development held in Rio de Janeiro in 1992, and the world summit on sustainable development that took place in Johannesburg in 2002 set the stage by laying down a solid foundation reiterating her commitment at the highest level in order to integrate the environmental and developmental issues aimed at achieving sustainable development goals. The concept of sustainable development is now a widely used term in many areas of activities related to the human life. It appeared in the second half of the twentieth

century as a reaction to the dynamic economic growth seen in many countries around the world, which was often observed in conditions of excessively intensive and uncontrolled use of natural resources [1]. Therefore, to reduce this unfavourable phenomenon in the world, at the end of the 1980s, a report from the world commission on environment and development of the UN called *"our common future"* was published in 1987 by a committee chaired by Gro Harlem Brundtland, and hence, this report is often referred to as the Brundtland report. The document states that to ensure the further existence of life on Earth and the possibility of meeting the basic needs of its entire people, and those of future generations, it is essential to have a sustainable development for all the areas of life and human activity. In doing so, this report provided the oft-cited definition of sustainable development as "development that meets the needs of the present time without compromising the ability of the future generations to meet their own needs" [2]. Although vague, this concept of sustainable development aims at maintaining economic advancement and progress, while protecting the long-term value of the environment; it provides a framework for the integration of environmental policies and development strategies (UN general assembly, 1987). It contains two key concepts: the concept of needs, in particular, the essential needs of the world's poor, to which over-riding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the ability of the environment to meet these present and future needs [3-5]. The connections between the environment and development thus provide a powerful rationale for environmental protection: enlightened self-interest [6]. This inherent inter-dependence between the long-term stability of the environment and the economy is the foundation of the field of sustainable development. Similar to the Porter's win-win hypothesis, in which a trade-off is not necessary, the sustainable development policies seek to tackle the sources of environmental degradation, not just the symptoms, while still providing opportunities and creating incentives for economic advancement [7]. Components of a healthy environment such as clean air and water are considered public goods in that they are non-rivalrous and non-excludable. Thus it is up to the public sector to maintain the provision of these goods and services. More recently, nations have moved towards the implementation of these market-based mechanisms to internalize the complete costs of pollution and ensure long-term stability of the environment; in other words, to ensure a sustainable development.

Another way to define sustainable development is in what it specifically seeks to achieve [8]. In order to illustrate this, it is helpful to examine three sets of goals that use different time-horizons: the short-term (2015) goals of the millennium declaration of the UN; the two generation goals (2050) of the sustainability transition of the board on sustainable development; and the long-term (beyond 2050) goals of the great transition of the global scenario group. To mark the millennium, the heads of states gathered in New York at the UN in September 2000. There, the UN general assembly adopted some 60 goals regarding peace; development; environment; human rights; and the vulnerable, hungry, and poor Africa; and to the UN, many of these contained specific targets such as cutting poverty in half or insuring universal primary school education by 2015. For eight of the major goals, the progress was monitored by the international agencies. In 2004, these agencies concluded that at the current rates of progress, many countries will fall short of these goals, particularly in Africa. However, the goals still seemed attainable by collective action of the global community and national governments. To attain these objectives, the millennium project, commissioned by the UN secretary general, has recently estimated that the additional financial resources that would be required to meet the millennium development goals are $135 billion in 2006, rising to $195 billion in 2015. This roughly represents a doubling of official aid flows over current levels, and is still below the UN goal of aid flows from industrialized to developing countries of 0.7 percent of the gross national product for industrialized countries [8].

Although many definitions abound, the most often used definition of sustainable development is that proposed by the Brundtland commission [6, 9-11]. The explanation does, however, touch on the importance of inter-generational equity. This concept of conserving resources for future generations is one of the major features that distinguish sustainable development policy from traditional environmental policy, which also seeks to internalize the externalities of environmental degradation [12]. Also the polluter pays principle states that "governments should require polluting entities to bear the costs of their pollution rather than impose those costs on others or on the environment" [6]. Thus government policy should

ensure that the environmental costs are internalized wherever possible; this also serves to minimize externalities [12].

The sustainable development in mineral resources has become a major challenge for today's global world, addressed to mining companies, scientists associated with mining and many other institutions and organizations. According to [1], the sustainable development of mining is the key to the security of raw materials and energy for many countries in the world.

Cameroon is often referred to as the "hinge of Africa" for its central location in the continent of Africa, and was selected as a case study because it has a strong geological potential for a number of mineral resources that, if well managed, could support economic growth through development of the mining sector. The country contains potentially large deposits of iron ore, gold, bauxite, diamonds, limestone, and nickel, among others. Despite its geological wealth, however, mining has never played a major role in Cameroon's development, and remains on the margins of the economy. Artisanal mining is the basis of community's livelihoods in several regions rich in gold or precious stones but inadequate regularization prevents the sector to really contribute to the economic growth.

Therefore, a study on the current state of sustainable development in the Cameroonian mining industry permits the identification of key points for improvement in order to position the country towards a sustainable mining industry in the future. This article aims at achieving the following objectives:

- To describe the past and current states of sustainability in the Cameroonian mining sector including the turn of events leading to the current state of affairs.
- To identify key areas of improvement so that the country can better position itself towards sustainable mining in the future.

The methodology used in this article is a single case study focused on the review of sustainable development in the Cameroonian mining industry up to date.

It includes scientific studies, reports of ministries and support organizations, national laws and regulations, and mining permits related to the area of study. Also corporate sustainability reports of mining companies and mining stakeholders are analyzed. This work covers the latest developments in terms of the institutional and regulatory framework for mining and environment in the country, history of mining in Cameroon, evolution and issues of the environmental, and social impact assessment (ESIA) system in Cameroon's mining sector until 2016. The paper concludes with the current challenges of implementing sustainable development in mining as well as future directions that research works on this area should take.

2. Background

Mining is a major economic activity in many developing countries [13, 14]. Over the past two decades, artisanal and small-scale mining (ASM) has grown at an exponential rate across sub-Saharan Africa. Here, activities occur in remote areas, and engage the poorest of people [15]. Operations, whether artisanal, small or large-scale, are inherently disruptive to the environment [16], producing enormous quantities of waste that can have deleterious impacts for decades [14]. The environmental deterioration caused by mining occurs mainly as a result of inappropriate and wasteful working practices and rehabilitation measures. Mining has a number of common stages or activities, each of which has potentially-adverse impacts on the natural environment, society and cultural heritage, health and safety of mine workers, and communities in close proximity to mining operations [17, 18]. As indicated in [19], the social and environmental impacts are more pervasive in regions where operations are newly-established or are closing down.

Artisanal mining is associated with a number of environmental impacts, which are deforestation, land degradation, open pits that pose animal and human traps, health hazards, mercury and cyanide pollution, and dust and noise pollution. A large proportion of artisanal miners are unaware of the laws governing mining activities and the environment [20, 21]. It has been estimated [15] that ASM generates up to five times more income than other rural poverty-driven activities including agriculture and forestry, and that it employs ten times more people than large-scale mining. In addition, ASM stimulates considerably more local economic development than recognized [22].

The Republic of Cameroon is centrally located within Africa, and lies between latitudes 1838 and 13805 N and longitudes 8833 and 16816 E (Figure 1). It has a total surface area of 475,400 square kilometres, with proximately 400 Km of coastline [23]. The country is divided into 10 administrative Regions (formerly called Provinces), and has an estimated population of 19.3 million. Approximately 57% of the

population live in urban areas, while 43% live in rural areas [24].

Cameroon is endowed with abundant mineral resources of international value including gold, diamond, bauxite, rutile, uranium, nepheline, wolframite, tin, cobalt, nickel, manganese, and iron ore (Figure 2). There is a limited geological mapping of these minerals that explains the limited number of large-scale mining operations in the country [25]. Natural resource management has a long history in Cameroon. It began before colonial administration within village communities and continues through today's numerous ministries.

Despite encouraging signs, the country still lacks the necessary mechanisms to take advantage of its mineral endowment. Management capacity and governance in the mining sector in Cameroon need to be improved to provide an enabling environment for long-term investments and allow the sector to resist economic and political cycles. The key challenges related to the mining sector in the country can be addressed in an integrated manner if sector management, transparency, and accountability are improved.

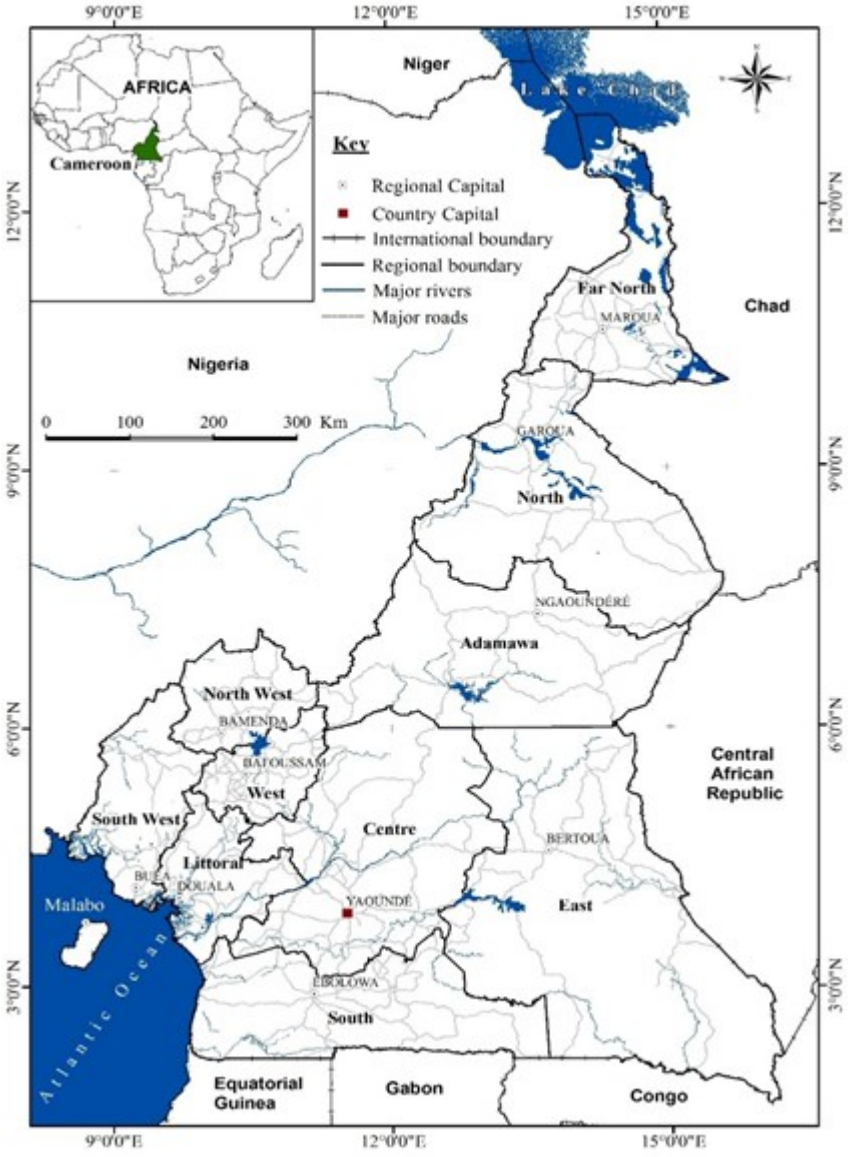

Figure 1. Map of Cameroon showing its location in Africa.

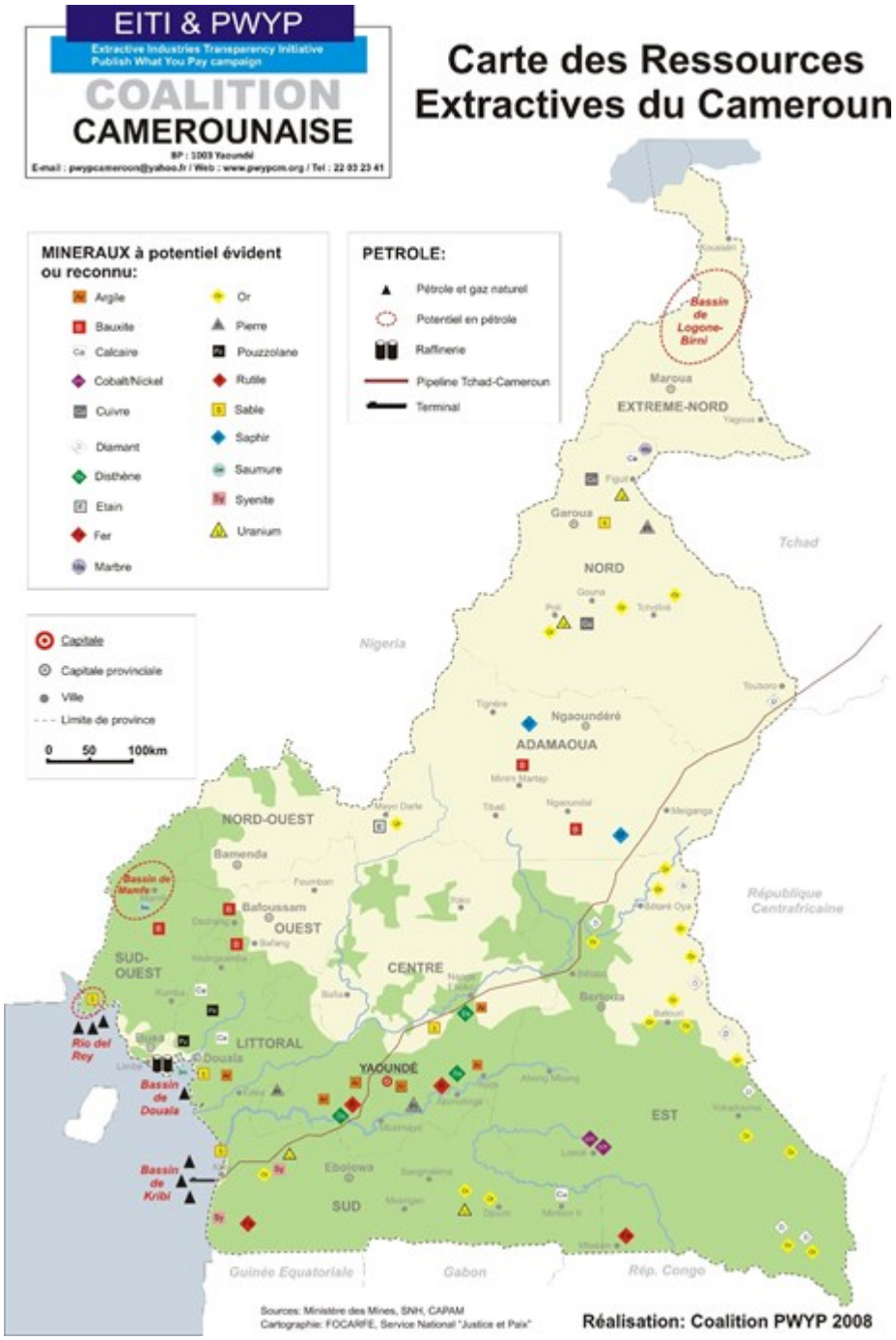

Figure 2. Map of mining activities in Cameroon.

3. Institutional and regulatory framework for mining and environment in Cameroon

Natural resource policy in Cameroon is as old as Cameroon itself. Before the arrival of the first colonial administrators in 1900, natural resources were managed according to the people's law (i.e. family law); the village chiefs were the main administrators of resource management. After the arrival of the first colonial administrators, natural resources that belonged to the people became the property of the first administration, and a formal administrative structure evolved. From 1960 (when Cameroon became politically independent) to the present, natural resources have been under the responsibility of numerous ministries.

The exploitation of natural resources in Cameroon generates significant revenue for the state budget, allowing the government to perform its sovereign task of investing in the country's development and the well-being of its people [26, 27]. However, the exploitation of natural resources often has negative consequences on the local communities who live in project areas [15, 21, 22, 28, 29]. Local communities are often frustrated when they

see "their" resources disappear, their lives destroyed, and no concrete improvements in their standard of living. It is in recognition of the negative impacts of these projects on local communities and the environment that the Cameroonian Government provides a royalty at the local level in some economic sectors, notably mining and forestry.

3.1. Legislation and policy on mining

All Cameroon's mineral resources belong to the Government. Prospecting, exploration, and development activities for any mineral deposit are regulated by law and require a license or permit.

For a long time, artisanal gold mining remained a quasi-illegal activity with the product sold quite through the informal circuit since the miners regarded themselves as outlaws [28].

Cameroon's geological and mining sector has two main areas of focus: scientific and industrial. The Ministry of Scientific Research (MINRESI) oversees a variety of research institutes in the areas of geology, geophysics, hydrology, and energy. The Ministry of Industries, Mines and Technological Development (MINMIDT) is responsible for industrial development through the Directorates of Mines and Geology [21]. The Institute for Geological and Mining Research (IRGM) of the Ministry of Scientific Research (MINRESI) is the agency responsible for oversight of the mineral sector. IRGM is also responsible for all the geologic and mining activities. These include conducting geologic exploration and deposit evaluation programs, while responsibilities of MINMIDT include mechanized drilling operations; overseeing the mining of mineral deposits; and preventing unauthorized exploitation of mines and quarries [30].

Several laws under different ministerial departments each regulate mining in Cameroon, with each playing a specific role: notably the mining code, tax code, other laws governing the fiscal regime, and laws governing the environment.

In 2003, the government established CAPAM (Government Support Scheme for Artisanal and Small-Scale Mining) as a vehicle to help formalize the sector [25]. The primary purpose of CAPAM is to assist and promote ASM [31-33] in an area where there are conflicting interests including conservation, alternative rural livelihoods, and large-scale mining concessions [25].

Cameroon Government involvement in the ASM sector is through the Divisional Delegations and CAPAM. The former is responsible for licensing, while the latter is the government's main buying agent; but there is little evidence of coordination between these two government bodies–where their remits are either undocumented or inexistent [25]. In relation to policy formation, implementation, and monitoring, this is not unusual in Cameroon as has been documented elsewhere in relation to waste management [34], land contamination, and environmental degradation [24].

While CAPAM is providing support to some miners, the lack of a coordinated approach within a wider sustainability agenda is likely to be unsuccessful in the medium to long-term [25].

3.1.1. Mining code

The Mining Code of 2001 adopted and promulgates Law No. 001 of 16 April 2001, and its Application Decree No. 2002/046PM of 26 March 2002 regulates the mining sector in Cameroon. The mining code was voted by the national assembly and promulgated by the head of State under Law No. 001 of 16 April 2001 (Republic of Cameroon, 2001) and Application Decree No. 2002/046PM 26 March 2002 (Republic of Cameroon, 2002) signed by the prime minister. This law revoked any other existing law that regulated the mining sector before then, notably Law No. 64/ LF/3 of April 1964 governing mineral substances and Law No. 78/24 of December 1978 fixing the fiscal regime for collecting mining revenue. The new law is more detailed than the old one. Made up of 116 articles, we notice significant advancement in several domains such as protection of the environment, recognition of the status of artisanal miners, and encouragement of foreign investment [31]. In Chapter 1, Article 2, artisanal mining is defined as "any mining activity consisting of extracting and concentrating mineral substances by means of manual and less mechanized methods and techniques" [21, 28]. The law limits the site of artisanal exploitation to be a quadrilateral with a side not greater than 100 m, and not greater than 30 m in depth [28]. Article 4 of Cameroon's mining code states that all national lands are open to mining except for areas excluded by law. In article 62, the mining code requires the approval from the "competent" government authorities for operations to be conducted in or around national parks, and protected areas subject to international agreements. In the case of all protected areas in

Cameroon, the competent authority is the Minister of Forestry and Wildlife [35]. In article 5, the Ministry of Industries, Mines and Technological Development (MINIMIDT) may also, via a public decree, declare certain areas off limits to all mining activities if it is deemed to be in the general interest of the state.

In 2010, an amended Mining Code was promulgated, modifying a few articles of the 2001 Mining Code. The World Bank has not been associated with this recent revision but could potentially provide support to the preparation and adoption of subsequent regulations. Despite the clear regulations governing mining activities in protected areas, these legal provisions have not been respected in the granting of recent mineral exploration permits [35]. Also another challenge recognized by the 2001 Mining Code is to mitigate problems related to ASM and large-scale mining (LSM) occurring on the same site [33].

The new mining code (revised version 2010) has just been published Promulgated by the Head of State of Cameroon on December 14, 2016, Law 2016/017 of December 14th 2016 on Mining Code. The bill initiated by the government on instructions of the President of the Republic seeking to strengthen and improve the legal framework of mining activities in the country. This new legal framework is the result of the in-depth review of the existing mining legislation. Indeed, expected for some years now, the new Cameroonian mining code finally came out of the government's drawers. As mentioned earlier, developed in 2001, then revised in 2010, the Cameroonian mining code certainly boosted the interest of some investors in the local subsoil resources but has not really enabled the country to benefit from the potential in its mining sector, which still represents barely 1% of the country's GDP.

Additionally, these past years, the Cameroonian mining sector has been characterized by a disorganization in the mining industry, the absence of industrial mining, scavenging of natural resources, and the inefficient monitoring of mining activities by the competent authorities. In addition to fine-tuning transparency in the mining sector in the country, the new Mining Code includes, among other things, the introduction of better governance, through the rationalization of the allocation of permits and sites, the customs facilities during the research phase, the institutionalization of the principles governing Extractive Industries Transparency Initiative (EITI), and the Kimberley Process Certification Scheme (KPCS) as well as improving the linkage between the mining law and state, land, and forestry legislation. The new Mining Code also prescribes the institutionalization of semi-mechanized artisanal mining, the creation of public-interest careers dedicated to the realization of public works, the maximization of state revenue from mining, and the creation of a sequestration account domiciled at the Central Bank to guarantee the development and strengthening of the mining sector. In short, the new Mining Code is more attractive and more competitive for potential investors.

The tax code is the responsibility of the Ministry of Finance (MINFI). This ministry collects government revenue (customs and taxes) from different activities in the country under different directorates [21].

However, the new Mining Code is more detailed as it highlights new articles to include industrialized mining, environmental protection, and royalty to the local population but failed to include sustainable development but not in a broader view.

3.1.2. National strategies and programs

Cameroon, with the support of its partners, particularly the World Bank, is improving the governance in the mining sector. The Mining Sector Capacity Building Project (PRECASEM) started in 2011 with the objective to improve (i) the efficiency and transparency of mining sector management; and (ii) the frameworks for sustainable mining development [35].

3.2. Some Cameroon national environmental laws and decrees

The main laws and decrees governing environmental and social management in Cameroon are described hereafter [36].

3.2.1. Law n° 96/12, 5 August 1996: environmental management framework law

Stemming from the national environmental management plan (1996), this law sets the general legal framework for Cameroon. It relies on six main principles (precautionary, preventive and corrective action, polluter pays, responsibility, participation, and subsidiarity).

Title I Chapter 2 on impact assessment stipulates at article 17 that: «the promoter or owner of any works that may, due to its dimension, nature or environmental incidences harm the environment, needs to conduct, according to the prescriptions of

its terms of reference, an impact assessment evaluating the direct or indirect incidences of the said project on the ecological balance of the implementation area or any other region on the quality of life of local population, and, more generally, on environmental incidences».
Article 55 requires from any owner of an industrial or commercial unit (see «law/decree of 14 July 1998 on company considered dangerous, unhealthy or inconvenient») the preparation of a risk assessment before the opening of the unit in order to prevent and control potential accidents.
Article 56 prescribes to all owners of any first or second-class plant, as defined in the «établissements classés» (gazetted units) the preparation of an emergency plan involving the call for alert among the competent authorities and riparian populations in case of potential or actual industrial accident, staff evacuation, and ways and means to control the root causes of the accident.
Two application texts have, in 2005 and revised in 2013 and 2016, specified the application modalities of the 1996 framework law:

- ✓ Decree n° 2013/0065/PM dated January 13, 2013 setting ESIA preparation and processing modalities,
- ✓ Ministry of Environment's (MINEPDED) order n° 00001/MINEPDED dated February 8, 2013 setting the categories of operations that are subject to ESIA.

According to article 2 of Decree n°2013/0065/PM, «EIA is a systematic analysis aiming at the determination of whether or not a project has a harmful effect on the environment».
EIA should include:

- ✓ the description and analysis of the initial state of the site and its physical, biological, socio-economic, and human environment,
- ✓ the description and analysis of all the elements and natural/socio-cultural resources potentially affected by the project as well as the site selection rationale,
- ✓ project description and rationale for its selection among competing activities,
- ✓ identification and assessment of potential project implementation effects on the natural and human environment,
- ✓ indication on the measures proposed to avoid, minimize or eliminate the potential environmental damages,
- ✓ a program for awareness building and public information along with proceedings of the meetings held with populations, NGOs, trade unions, opinion leaders, and other organized groups as relevant to the project,
- ✓ the environmental management plan (EMP), including monitoring mechanisms and, as relevant, the compensation plan,
- ✓ the terms of reference of the study as well as the bibliography,
- ✓ a summary, in simple language, of the key specific information.

According to the Ministry of Environment's order n° 00001/MINEPDED, projects concerning industrial mining and quarries are subject to detailed ESIA (article 4), whereas ASM is subject to summary ESIA (article 5).

3.2.2. Law n° 2003/003, 21 April 2003: law on phytosanitary protection

It stipulates that chemical treatments should be conducted with due respect for the agricultural good practices so that human and animal health and the environment be all protected. Only the certified phytosanitary products and those benefitting from a temporary sale authorization should be used in Cameroon.

3.2.3. Law n°98/015, 14 July 1998: law on gazetted and hazardous industrial units

Depending upon the hazards generated and/or the potential nuisances, gazetted units are split into two classes (Article 3).

3.3. Ministries and institutions

In Cameroon, the principal ministries and institutions involved in the regulation of the laws on the environment, the social and archaeological aspects are:

- The Ministry for Industry, Mines, and Technological Development (MINIMIDT);
- The Ministry of Environment, Protection of Nature and Sustainable Development (MINEPDED);
- The Ministry of Forestry and Wildlife (MINFOF);
- The Ministry for the Economy, Planning, and Regional Development (MINEPAT);
- The Ministry of Energy and Water (MINEE);
- The Ministry of Public Works (MINTP);
- The Ministry of Public Health (MINSANTE);

- The Ministry of Territorial Administration and Decentralization (MINADT);
- The Joint Ministerial Committee for the Environment, which reports to MINEPDED.

All these ministries are located at the heart of the political capital of the country, and are respectively represented at regional and departmental level by regional and departmental delegations.

4. History of mining in Cameroon

Cameroon began developing its extractive industries during the German, French, and British colonial periods. Cameroon's mining sector boomed during World War II to represent 20% of the country's GDP but quickly fell to less than 1% after independence [37, 38].

Informal ASM operations are known to be widespread in the country [32], little is known about their scale and dynamics, and most importantly, their productivity and the levels of income they provide. A limited number of studies [32, 39] have been undertaken in relation to the scale or dynamics of the ASM sector.

The country launched an ambitious mineral exploration campaign in the 1970s, which identified major resources of gold, diamonds, iron, bauxite, uranium, cobalt, and nickel [27]. However, despite these discoveries, mining continues to be an underdeveloped sector in the country, contributing less than 1% of GDP annually. Economic incentives are now in place and a competitive environment has been created to encourage private investments in mineral exploration and extraction activity with the aim of boosting the sector. In general, there is less evidence of strong interactions between mining and agriculture in Cameroon, although [40] has postulated that mining infra-structure will stimulate agricultural expansion in forest areas.

Notwithstanding, a lot of mineral substances are still to be discovered. Exploration opportunities of the country remain quite open since less than 50% of the territory is known with precision. Cameroon has approximately 360 districts with each district having a specific mining potential that can be exploited and developed through industrial or artisanal and small-scale mining. Despite this, with an ambition of becoming an emerging mineral producing country, Cameroon counts on its significant mineral potentials partially explored and un-mined.

Today, a new model of small-scale mineral exploitation is being driven by Asian investors in East Cameroon, and may be the representative of trends elsewhere in Africa [41].

4.1. Cameroon mining sector overview

Geologically, Cameroon is characterized by an Archaean basement, Proterozoic volcano-sedimentary packages (similar to that of the auriferous Birimian belt of West Africa), and several late stage intrusive phases. Cameroon has extensive bauxite reserves at Minim–Martap and Ngaoundal but requires substantial infrastructure development in order to exploit them. These two northern deposits have an estimated combined resource of 1100 Mt of bauxite. Alucam is Cameroon's largest aluminium company, and its aluminium smelter produces 90,000 t/year of aluminium from bauxite, currently imported from Guinea. The Mbalam Iron Ore Project is located in close proximity to the Belinga Iron Ore Project in Gabon, which is being developed by the China National Machinery and Equipment Import and Export Corporation (CMEC). The Mbalam and Belinga Projects form part of an emerging iron ore region that extends through the Republic of Cameroon, the Republic of Congo, and Gabon.

The artisanal mining sector was organized even before national independence (e.g. Gold mining in Cameroon started in 1933), contributing up to 20% of the economy. After independence, the activity continued but was hindered by smuggling and by exploitation of local actors. Numerous artisanal gold mining sites are known (producing around 1500 Kg/year) but it appears that no modern exploration methods have been used to locate Cameroon's primary gold potential [42]. The resources mined in Cameroon are limited, with annual artisanal production of around 1500 Kg of gold and 12000 carats of diamond [43] as well as various industrial materials. To date, no primary gold deposits have been located [33]. However, work carried out by the *Bureau de Recherches Géologiques et Minières* (BRGM) suggests that gold mineralization is related to the volcano sedimentary belts characteristic of the Birimian belt in Niger, Burkina Faso, and Mali.

Alluvial gold production is derived from eluvial and alluvial workings. The effect on miners is a contradictory creation of both significant wealth and extreme poverty, with very limited contributions to national economies. Despite the richness of the Cameroonian basement, solid mining in the 1997/98 fiscal year contributed only 4.8 billion CFA or 0.08% to GDP [38]. The

absence of a coherent operational strategic code was blamed for the relegation of the mining sector in favour of agriculture and other sectors as pillars of development. However, in the recent years, there has been a revamping and reorganization of the mining sector. The government is currently examining the assistance it gives to the artisanal mining sector [44].

Almost all artisanal mining sites in Cameroon are covered by industrial mining research permits. In 2003, there were only two such permits [45] but today there are over 167 exploration permits.

However, the local miners are wary of the presence of mining companies, fearing they could be evicted when the company starts operations [33]. In response to this, the 2001 Mining Code of Cameroon tries to resolve problems related to small-scale mining and large-scale mining (LSM) operations at the same site.

As of October 2016, Cameroon had no industrial mining exploitation permits, and alluvial gold is artisanal exploited from stream gravels in parts of the country.

4.2. Cameroon's mining potential

Besides oil and gas, the country contains potentially large deposits of iron ore, gold, bauxite, diamond, pozzolana, limestone, rutile, sapphires, rubies, nickel, manganese, cobalt, nickel, cassiterite (tin), molybdenum, and uranium among others. Most of the resources are yet to be exploited.

Since the publication of a business-friendly Mining Code in 2001, over 167 exploration permits have been issued to mining companies, for only 40% of the Cameroonian territory explored. Some of the companies have effectively started mineral exploitation. The granting to date of five (05) exploitation permits (nickel-cobalt, diamond, limestone, and marble). The Cameroon & Korea Mining Incorporation (C&K Mining Inc.) industrial diamond project is one of the first companies to start industrial mineral exploitation among the new wave of mineral exploitation companies in Cameroon. Many more of such mining companies may also start their operations in the coming years. In addition to its industrial mining title "Mobilong", C&K Mining Inc., operates semi-industrial exploitation gold at Bétaré Oya and Bindiba/Garoua Boulaï in the East region of Cameroon. It has a third exploitation permit for gold (small mine) in the locality of Woumbou (East). According to the government, Cameroon has about 140 identified gold deposits. Most of these deposits are mined by artisanal miners but with the recent expansion of the gold mining sector, this is about to change in the coming future. Potential bauxite reserves (the main source of aluminium) exist at the Minim-Martap and Ngaoundal deposits, located in the remote northern parts of Cameroon. As per estimates, these two deposits hold a combined resource base of about 1,100 million tons of bauxite. Aluminium is produced as a metal through smelting at Edea (owned by ALUCAM) but the raw material (bauxite) is not mined in Cameroon but imported from Guinea [46-48].

The country is expected to become a significant centre for iron ore production as several major mining projects are expected to come online over the coming years. The abundance of iron ore reserves is expected to attract foreign investments, especially from Chinese investors interested in securing stable and long-term supply of iron ore [46, 49, 50].

The only significant mining commodity produced in Cameroon remains in 2016 is pozzolana (siliceous volcanic ash used to produce hydraulic cement). The other commodities are clay, sapphire (mostly through artisanal mining operations), sand, limestone, and marble.

Further development of Cameroon's mineral industry continues to be delayed in 2016 owing to inadequate infra-structure (poor transport infra-structure), insufficient electrical power, and a lack of finance. Cameroon also has hydropower potential that has remained undeveloped. The Mining Sector Capacity Building Project was signed by the Government and the World Bank in mid-year 2012. The purpose of this $30 million technical assistance project was to improve efficiency and transparency in the mining sector and to provide the framework for sustainable development in the sector. The project would focus on strengthening institutions and promoting regional integration of mining activities [35, 51].

4.3. General framework of local content applicable to mining companies in Cameroon

A reading of the local content requirements of mining companies could be done through actors of monitoring and the legal framework of their obligations.

4.3.1. Actors monitoring social obligations of mining companies

Monitoring of social obligations of mining companies is done by two main groups of actors in Cameroon, namely those in the public sector and non-governmental organizations.

- **Actors in public sector**

Generally, some actors in the public sector through the Ministry of Mines, Industry, and Technological Development (MINMIDT) are involved in the control of mining projects. The ministry of Mines, Industry, and Technological Development works with other administrations such as the Regional and Divisional offices of ministry in the monitoring of local content requirements. IRGM (Institut de Recherches Géologique et Minières) are charged with establishing mineral resource maps of Cameroon

- **Non-governmental organizations**

Many national and international NGO operate in Cameroon. The Centre for Environment and Development founded in 1994 is an NGO specialized to the fight of local communities' rights against extractives industries. The association «Forêts et Developpement Rural» (FODER) created in December 2002 also fights for transparency in the extractive industry.

- **Other actors**

Other organizations are involved in monitoring the social obligations of mining companies. This is particularly true for national and international civil society organizations. The example of GIZ Office in Cameroon could be cited.

4.3.2. Legal framework

The legal framework of the obligations in the mining sector is made up of law n° 001-2001 of 16 April 2001 establishing the Mining Code and its amendment of 2010 together with its application decree (Law n°2002/848 PM of 26 March 2002) and also Law n° 92-007 of 14 August 1992 establishing the Labour Code in Cameroon.

- Provisions of Mining Code (amended)

Within the framework of a mining agreement signed between the Government of Cameroon and a mining company, Article 16(1) of the Amended Mining Code states that "*For the development and exploitation of a mineral discovery or for its funding, a mining agreement is concluded between the holder of an exploration permit and the State. The said agreement includes provisions on:*

- *Obligations relating to employment, vocational training, and social achievements;*
- *Relationships with suppliers and sub-contractors;*
- *(New) the percentage of the production of minerals extracted to be devoted to local transformation. This percentage cannot be less than 15%.*
- *Any other matter that the parties of the agreement may find of interest"*

It comes out clearly from this provision that local processing, source of employment, and wealth creation at the local level are of utmost importance in the agreement. This involves the transfer of skills and capacity building. The production-marketing chain in which suppliers and sub-contractors are involved is also included among the obligations of companies.

- The application decree of the Mining Code

The provisions relating to the obligations in terms of Local Content are mentioned in Articles 65 and 128 of Decree No. 2002/648/PM of March 26, 2002-laying down detailed rules for the application of Law No. 001 of 16 April 2001 on the Mining Code. Thus in Article 65 (2), it states that *"The application for the award of an exploitation permit is addressed and compiled to the Minister of Mines before the expiration date of the exploration permit from which it is derived.*
It states:

✓ *The period for which the exploitation permit is requested*

It is accompanied by:

✓ *A feasibility study including notably:*

- *f) a note on the socio-economic impact of the project, on local residents in particular;*
- *k) proposals of the applicant on the recruitment and training of Cameroonians.*

In Article 128, it also states: "*During the exploitation phase, the management plan describes the management of impacts due amongst others to the following: [...] eventually positive social impacts such as jobs, training opportunities, and the provision of communications and infra-structure."*

It is noted that the Mining Code and its application decree contain elements that are part of all provisions relating to local content requirements. However, it seems important to also note that this concept has proved to be insufficiently integrated into the objectives of the Cameroonian legislation as formulated in the gas code of 2012.

5. Environmental problems in mining sector in Cameroon

In Cameroon, the major environmental problems in mining sector are land degradation, water and air pollution, vegetation clearance (deforestation), ecological disturbance, degradation of natural

landscape, geological hazards, and destruction of wildlife habitats (Figure 3). These diminish freshwater availability and agricultural productivity, thereby increasing the rate of food insecurity, famine, and health diseases. These problems bring negative points to the sustainable development of the mining sector in Cameroon.

Figure 3. Some environmental problems faced by mining sector in Cameroon: (A): Land degradation due to gold mining activities in Batouri, (B): Water polluted by chemicals products in Bétaré-Oya, (C): Water polluted in Ngoura, (D): Air pollution, (E): Deforestation, (F): Abandoned mining pit, (G) and (H): Ecology disturbance and children involved in mining activities.

6. Evolution and issues of Environmental and Social Impact Assessment (ESIA) system in Cameroon

The environmental movement first touched the industrialized countries, and then, especially after the early 1990s, developing countries including those of Sub-Saharan Africa. In the late 1990s, most of these countries saw the rise of environmental assessment (EA). They were influenced by the 1992 Earth Summit as well as by the World Bank, which imposed it as a condition for development aid. This aspect, in particular, has taken the form of the adoption of legislation and regulations requiring the use of these procedures. This drive to institutionalize environmental assessment will remain inadequate unless EA becomes part of an adaptive process mindful of the contextual characteristics, in order to assure, beyond the enactment of laws and the creation of structures, the effectiveness of the system of impact evaluation as a whole [52, 53].

Along with the dissemination of environmental assessment as a useful innovation in fighting pollution and in proactively preventing environmental degradation due to mindless, runaway industrialization, there has been an expansion of the concept of the environment and the birth of the idea of sustainable development [54].

At the beginning of the 1970s, the environment had a biophysical connotation. The essence of the concept was the physical-chemical and biological elements surrounding humanity. Environmental protection laws were aimed at combating pollution. Today, the environment is seen more as an organized and dynamic system of interactions between biophysical and human factors, in which organisms evolve and in which human activities take place [55]. Therefore, the environmental system now appears to be a socio-ecological system.

Environmental assessment can be defined as the set of procedures aimed at integrating aspects connected to the natural and human environment in making decisions related to the design, planning, implementation, and monitoring of interventions, with an eye to balanced and sustainable development. The best-known form of environmental assessment in Cameroon is still the Environmental Impact Study (EIS) used in projects under appraisal. More and more use is being made of environmental audits of projects already being executed, and what is known as Strategic Environmental Assessments (SEAs), which cover policies, plans or programs [54]. Incontestably, environmental assessment seems to be one of the principal ways for sustainable development actors to contribute to the integration of aspects related to governance and sustainability in development processes in the country.

6.1. Legal and institutional guides of ESIA in Cameroon

The principle of taking the environment into account in public action is enshrined in Cameroon's constitution of 1996, thus emphasizing at the highest possible level the country's commitment to sustainable development. The preamble of the constitution proclaims the right of every citizen to a healthy environment. It states that protecting the environment is a duty for everyone, and that the state ensures its defence and promotion. This willingness to take the environment into account in development projects has created a relatively complex legal and institutional framework.

Although the law no. 94/001 of 20 January 1994 on forests, wildlife and fisheries already explicitly required an EIA for projects that could impact the ecological balance of forests, it is law no. 96/12 of 5 August 1996, establishing a more general framework for environmental management; that is devoted to the principle of ESIA. Its article 17 states that an ESIA is required for any project liable to have an impact on the environment. Subsequently, other sectorial laws such as the Mining Code make explicit reference to the requirement for an ESIA. At the regulatory level, decree n° 2013/0065/PM dated January 13, 2013 setting ESIA preparation and processing modalities, laid down the process and framework for carrying out an ESIA for the first time. It was followed by several orders including one detailing the list of projects required to undergo the procedure.

Cameroon at the institutional level seems to have opted for a multi-sectorial, regional, decentralized, and participatory approach to environmental management, coordinated by a ministry responsible for the environment, currently the Ministry of the Environment, Nature Protection and Sustainable Development (MENEPDED), assisted by an Inter-ministerial Committee on the Environment (ICE), whose missions include making recommendations on all impact assessments before the competent authority makes its decision.

6.2. Evolution of ESIA procedure in terms of legislation/regulations and practice

The quality of the texts greatly improved in Cameroon since 2005. The publication of the 2005 decree laid down the methods for carrying out EIA. Several orders have also helped improve regulatory provisions related to EIA, notably the order of April 2005 laying down the various categories of operations requiring an environmental impact study, of February 2007 defining in general the terms of reference of environmental impact studies and of July 2007 laying down the conditions for authorization of consultancies carrying out ESIA. However, certain requirements can still be refined, adapting them if necessary to the new policy directions of the decree of 13 February 2013, which lays down the procedures for conducting environmental and social impact assessments and the decree n° 2013/0066/PM dated January 13, 2013 setting environmental and social audits preparation and processing modalities. It has also been observed that the documents do not provide for the involvement of the environmental inspectorate at the various phases of ESIA [54].

With regard to knowledge of the legislation/regulations, more effort needs to be made, in particular with regard to a wider public. According to [54] about a quarter of the projects still do not undergo the procedure; the quality of the teams in charge of writing the reports as well as the quality of the content and clarity of the reports, although improving, still score moderately in practice.

Generally, a review of the evolution of the ESIA system in Cameroon shows that various orders and manuals need to be updated to reflect the decree of 13 February 2013. A significant improvement can be detected in the requirements governing all aspects of the ESIA procedure from screening to monitoring and compliance, although more precision is still necessary with regard to procedures and decision-making criteria. Improvement is also observed in knowledge of the laws/regulations and in monitoring during the implementation phase of the project. Institutional capacity remains relatively unsatisfactory because of weak institutional memory and relatively few requirements for expertise. Despite favourable regulatory provisions, there is practically no use of outside expertise. The aspects still with a weak regulatory framework and virtually absent in practice are the public nature of ESIA, public participation in decision-making, and the obligation to justify decisions. It is important to note the improvements in decentralization of the process introduced by the decree of February 2013, which entrusted the responsibility for impact statements to the municipalities.

7. Economic sustainability

The mining sector of Cameroon has not fully improved the economy of the country, althought there are quite good potential mineral deposit. This is due to poor infra-structure deficiency and a difficult business environment, rife corruption, observed growth in the oil sectors. The Cameroonian authorities have started to address the infra-structure problems, with several roads, port, and power projects currently at different stages of construction. With specific interest to the mining site to build railroads from iron ore and bauxite deposits in the south-eastern parts and central parts of the country respectively to the new deep-sea port at Kribi. Furthermore, the country has commissioned several hydro and thermal power stations to increase power supply to the nation's grid. Cameroon has significant hydroelectricity potential, said to be the third highest on the continent. Although access to electricity is relatively adequate in the cities and industrial areas, some 85 percent of people living in rural areas are not connected to the electricity grid. The World Bank in its Doing Business in 2016 survey ranked Cameroon 172th of 189 countries, four places weaker than the 168th ranking in 2015. As with many other franc zone countries (Former French colonies), Cameroon's business environment is weak, and a number of areas (paying taxes, enforcing contracts…) need to be improved significantly. These are among the most important considerations for foreign investors looking to expand into Africa, and the Cameroonian government needs to address these issues in order to attract more foreign investment in the future. Cameroon is well-endowed with commodities required for a healthy primary sector; however, in the recent years, the Cameroonian economy would be stagnated as oil production decreased and the non-extractive sectors struggled to grow, bogged down by severe infrastructure gaps and a difficult business environment. Cameroon's economic prospects rest on the recent revival of the hydrocarbon sector. In addition to the slight increase in oil output anticipated over the medium term, Cameroon's economic growth will be underpinned by infra-structure programs, support to the agricultural sector, and accelerated growth in the services sector, most notably

telecommunications and transport. The country has a considerable potential for mining and the government is now taking concrete steps to develop the sector as a priority sector as the country strives to achieve key economic goals by 2035 [46].

8. Towards sustainable mining practices in Cameroon

According to [35], the key parameters for sustainability include the Government's commitment to develop the sector within a sound environmental and social framework. Mining is a priority sector to bring enhance development and improvement of socio-economic conditions in Cameroon. Improving sector management will make benefits at the local level more concrete, while also increasing Cameroon's attractiveness to investors. In the long run, investments in the sector are expected to provide sustained revenues that can be used to help maintain sector oversight and management systems set up during the project (e.g. mining cadastre, inspectorate functions) as well as for wider development purposes.

9. Conclusions

This paper addresses the scarcity of information on the growing mining sector of Cameroon and the developments in the regulations and laws governing activities in the sector over the years. The growing mining sector poses a serious challenge to the government as they have to ensure control of the sector so that substantial revenue could be generated via taxes to boost the country's economy, especially with the drop-in oil prices worldwide.

Cameroon is a resource-rich country and its geological potential is promising for non-oil minerals. However, until industrial mines start producing and ASM well monitored, only then will the sector be a major contributor to the country's economy. Beyond the need for effective monitoring and the respect of contractual obligations between the mining companies and the government of Cameroon, it is necessary that the government signs contracts or conventions that allow it to capture maximum benefits from mining extractive projects. Also transparency and respect of the contractual obligations by the mining companies is essential for the government to effectively capture the benefits expected. As such, monitoring of company obligations is important for stakeholders for accountability purposes.

With the vast mineral resources in Cameroon, there is a great promise for the future of the country as it could grow into a major player in the mining industry (especially gold, diamond, iron ore, and bauxite extraction) of Africa and why not the World in the years to come. A steady and thoughtful growth toward a sustainable industry should have a great impact on the country's economy in the coming decades.

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بررسی توسعه پایدار و چالش‌های زیست‌محیطی در بخش معدنی کشور کامرون

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چکیده:

کشور کامرون دارای پتانسیل‌های زمین‌شناسی بالقوه‌ای برای تعدادی از منابع معدنی است که در صورت مدیریت صحیح می‌تواند باعث رشد اقتصادی کشور شود. این کشور دارای ذخایر بالقوه‌ی زیادی از سنگ آهن، طلا، بوکسیت، الماس، سنگ آهک، نیکل، سنگ‌های قیمتی و سایر فلزات گران‌بها است. با وجود ثروت زمین‌شناسی زیاد در این کشور، اما معادن هرگز نقش عمده‌ای در توسعه اقتصادی کشور کامرون نداشته‌اند. مطالعه در مورد وضعیت توسعه پایدار و چالش‌های زیست‌محیطی در بخش معادن این کشور، باعث شناسایی نکات کلیدی برای بهبود وضعیت کشور در راستای دستیابی به یک صنعت معدنکاری پایدار در آینده خواهد شد. این پژوهش به بررسی پتانسیل معدنکاری، مشارکت ذینفعان، قانون‌گذاری و سیاست معدنکاری در منابع معدنی کشور کامرون پرداخته است. این پژوهش شامل یک مطالعه موردی برای بررسی توسعه پایدار در صنعت معدن کشور کامرون است. این پژوهش شامل مطالعات علمی، گزارش‌های وزارتخانه‌ها و سازمان‌های حمایتی مربوطه، قوانین ملی و مقررات مربوط به حوزه مورد مطالعه است. همچنین گزارش‌های توسعه پایدار صنفی شرکت‌های معدنی و ذینفعان معدن مورد تجزیه و تحلیل قرار گرفته است. این کار تحقیقاتی، آخرین تحولات مربوط به چارچوب‌های نهادی و نظارتی معدن و محیط‌زیست، تاریخچه معدنکاری و سیر تکاملی و مسائل مربوط به ارزیابی تأثیرهای اجتماعی و زیست‌محیطی در بخش معدن در کشور کامرون تا سال ۲۰۱۶ را پوشش می‌دهد. این پژوهش به شناسایی چالش‌های موجود در پیاده‌سازی توسعه پایدار در معدن و همچنین جهت‌گیری‌های آتی در مطالعات تحقیقاتی در این زمینه پرداخته است.

کلمات کلیدی: منابع معدنی، توسعه اقتصادی، سیاست معدنکاری، ارزیابی تأثیرهای اجتماعی و زیست‌محیطی، توسعه پایدار.