

Mineral Rights Cadastre



Promoting Transparent

Access to Mineral Resources

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The World Bank Group's Oil, Gas, and Mining Policy Division

Oil, Gas, Mining and Chemicals Department

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Abbreviations and Acronyms

ANPM	National Agency of Mining Domain (Algeria)
BCMM	Madagascar Mining Cadastre Bureau
CAMI	Mining Title Registry and Cadastre Service (DRC)
CCS	Computerized cadastre system
CU	Cadastral unit
DRC	Democratic Republic of Congo
EI	Extractive industries
EITI	Extractive Industries Transparency Initiative
ESIA	Environmental and social impact assessment
ESMP	Environmental and social management plan
GIS	Geographic information system
GPS	Global positioning system
GS	Geological survey
ICMM	International Council on Mining and Metals
IMF	International Monetary Fund
ITRF	International Terrestrial Reference Frame
MAC	Mining Advisory Committee MAC
MI	Mining Inspectorate
MM	Ministry of Mines
MMMD	Ministry of Mines and Minerals Development
MRC	Mineral rights cadastre
PMI	Public mineral institution
UTM	Universal Transverse Mercator
VPN	Virtual private network
WBG	World Bank Group
WGS	World Geodetic System
ZCCM	Zambia Consolidated Copper Mines

Foreword

Since the late 1980s, a number of countries in Latin America, and later Africa and Asia, have undertaken mining sector reforms that support transparent, sustainable management of their natural resources as a way to maximize development gains and reduce poverty. At first, during times of low commodity prices, recommended reforms focused on securing sector investments and optimized fiscal models. These reforms were, in many cases, supported by the World Bank Group. Over time, these strategies began to include components to ensure proper environmental and social protection, as well as efforts to maximize the economic contribution of natural resource development to national and regional development.

More recently, the World Bank has increased its efforts to provide a more integrated and comprehensive approach to natural resource management, one that encompasses the full extractive industries value chain (the EI value chain) and includes all the phases and impacts of resource extraction (see Figure 1). As defined by the World Bank's Oil, Gas, and Mining Policy Division, the EI value chain, from a government perspective, includes the following:

- Award of Contracts and Licenses
- Regulation and Monitoring of Operations
- Collection of Taxes and Royalties¹
- Revenue Distribution and Management
- Implementation of Sustainable Development Policies and Projects

Figure 1: EI Value Chain



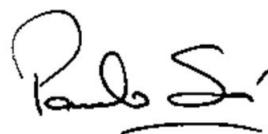
¹ Including, but not limited to, the Extractive Industries Transparency Initiative (EITI).

² Over 40 low- and middle-income countries are rich in hydrocarbon and mineral resources. See Guide on Resource Revenue Transparency, IMF (2007) for definitions.

The EI value chain aims to support countries in their efforts to translate mineral resource wealth into sustainable development. It can help resource-rich² countries to properly orient their EI sector policy at an early stage and, in doing so, to avoid the “resource curse”—the paradox whereby countries with large endowments of natural resources often suffer from low growth rates, high economic volatility, corruption, and, in some cases, devastating political conflicts and civil wars. Indeed, while revenues from EI may represent a key development opportunity, weak institutional capacity can leave many developing countries particularly vulnerable to the resource curse. The scope of this document falls under the first component of the value chain—“awarding contracts and issuing licenses.”

This document is one of the first on the topic of mining cadastre management. It takes stock of mining cadastre reforms in the past 10 to 15 years and delineates a number of lessons learned.

We hope this publication will further the discussion a number of topics, including “first-come, -first- served” principle and the auctions process for the mining sector; speculation, license administration, and capacity building. We expect that that the country case studies will help others just embarking on the institutional reform process and mineral rights cadastre implementation.

A handwritten signature in black ink, reading "Paulo De Sá". The signature is written in a cursive style with a horizontal line underneath the name.

Paulo De Sá
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I. Abstract

A. What Is a Mining Cadastre?

A mining cadastre is the principal public institution that manages mining titles in a country. Such a cadastre, when well developed and backed by capable public mining-sector institutions, integrates the regulatory, institutional, and technological aspects of mineral rights administration and forms the cornerstone of good mineral resource management in a country.

Governments normally grant mineral exploration and mining rights in particular areas by means of concessions, leases, licenses, and agreements. Efficient and effective granting procedures tend to be based on the following principles:

- A clear legal and regulatory framework
- Well-defined institutional responsibilities
- Transparent and non-discretionary procedures

In practical terms, the mining cadastre takes the following steps when administering mineral titles:

- Formally captures applications for various types of mineral licenses (that is, prospecting, exploration, mine development)
- Registers changes and updates to mineral titles any time a title is granted or an owner changed
- Checks license applications for possible overlaps with earlier claims or other impediments
- Advises the granting authority on whether a license application is technically admissible or not
- Ensures compliance with payment of fees and other requirements to keep a mining title valid
- Advises the granting authority when mining titles should be canceled



B. Principles Governing Mining Rights

Several core principles have been integrated into the legislation governing mining operations in most countries where mining activity is relevant. These principles are as follows:

- Mineral resources belong to the state.
- The right to explore and exploit the mineral resources may be temporarily transferred to an individual or a corporate entity through a written document, normally called a license or lease.
- The mineral rights granted through such a license or lease are considered real estate properties but are independent from surface or land ownership rights.
- The granted license or lease usually does not provide for visible physical boundaries (such as fencing); instead, the area is usually delimited by geographic references or coordinates.
- The holders of the granted license or lease must fulfill pre-established conditions to maintain their rights over the area.
- When the validity of the granted license or lease ends, the rights return to the state.

C. Mining Cadastre Principles

There are also several ground rules that should be observed for a mining cadastre to operate properly:

- *Security of tenure.* This refers to the security of title, the right to transfer the title to any eligible third party, and the right to mortgage the title to raise money. It also refers to the transformation of an exploration license into a mining license. In most countries, mineral rights are divided into exploration and mining (or exploitation) licenses. Exploration licenses give holders the right to explore and evaluate the economic viability of any mineral resources within the granted area. If an economic resource is confirmed, the exploration license must be transformed into a mining license for the holder to exploit it.
- *Security of title.* Licenses and mineral rights cannot be suspended or revoked except on specific grounds, which must be objective and not discretionary, and which must be clearly specified and detailed in the legal framework.
- *“First come, first served.”* Exploration licenses are granted on a first-come, first-served basis, which means that the first individual or company to apply for the rights to a certain area where mineral resources may exist will have the priority right to be granted the license or lease.
- *Auctions.* Many countries include provisions in their mining law to auction available areas when resources or reserves have been assessed or inferred within an acceptable range of probability.

World Bank experience in helping countries to establish mining cadastres has shown that *one size does not fit all* and that country-specific circumstances must be taken into account when designing and administering mining cadastres.

II. Introduction



A. Mineral Rights Management

During the past 25 years, many countries, particularly in Latin America, Africa, and Asia, have instituted legal and institutional reforms in their mining sectors to modernize sector management, attract investments, and optimize the contribution of mining to their economies at national and local levels. Some of these developments have led to impressive results, for example, in Argentina, Chile, Ghana, Madagascar, Peru, and Tanzania.

As with any land-related development policy and strategy, the success of mining sector development depends on the integrity of access to, maintenance of, and transfer of rights to mineral resources. For more than two decades, the World Bank has been providing technical and financial support to about 30 countries to help them modernize their legal and institutional frameworks for mining, including the establishment of efficient processes for granting and monitoring mineral rights.

This document proposes a set of generally applicable recommendations and good practices for creating a Mineral Rights Cadastre (MRC), an administrative body responsible for overseeing the process of granting and managing mineral licenses throughout a country. The document reviews lessons learned from World Bank–funded projects aimed at reforming mineral rights management and assesses the impacts and benefits of the implemented changes. The document focuses on the MRC system as a key regulatory agency of mining sector administration.

This study is also intended to fill a gap in the literature on mining sector administration, as few publications since roughly the 1930s have been dedicated to the overall analysis of MRCs, particularly in relation to modern and recent mining cadastral practices.³

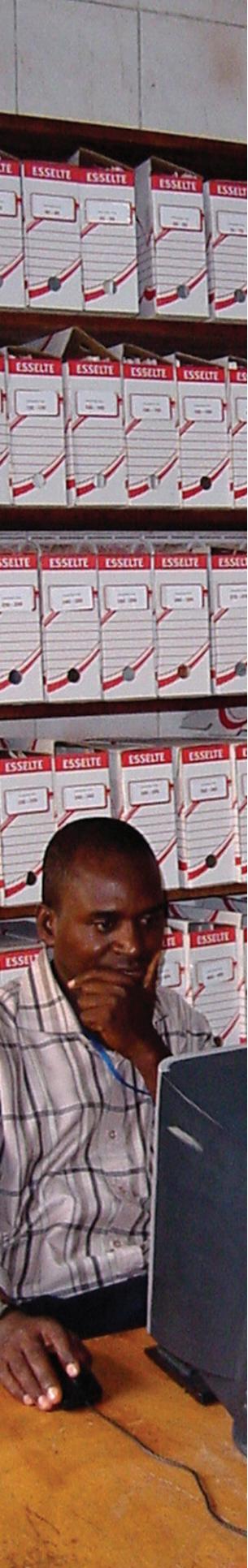
While the overall concepts and principles presented in this document are intended to be universally valid and applicable, there is no single solution to mining sector development, and it would be unrealistic to believe that actions that have been successful in one country can be directly transferred to others. The MRC of any given country will need to be adapted to that particular country's culture, tradition, existing legal framework, development capacity, and other factors. This document describes the trade-offs that may be necessary to arrive at an acceptable solution; using case studies, it also highlights concrete applications that can be recommended, based on typical country circumstances.

B. Definition and Evolution of the Term Cadastre

A cadastre⁴ is a comprehensive register of real properties or land parcels within a country or its administrative subdivisions. The cadastre commonly includes details of the ownership, tenure, precise location, dimensions, and value of individual areas. This usage dates back to antiquity, when the development of the concept of private ownership led to the need to register and list properties, both to establish taxation references for the state or kingdom and to ensure security of tenure for the titleholder (through publicity and transparency), as well as to avoid potential duplicate or overlap-

³ There are, however, a few articles describing country-specific experiences, often focusing on a particular aspect, such as application of information technology. In addition, some World Bank publications include a discussion on a mining cadastre as part of overall integrated sector reforms. See, for example: "Mining Strategy for Latin America and the Caribbean," World Bank WTP 345, 1996.

⁴ The word *cadastre* is variously attributed to the late Latin *capitastrum*, a register of the individual (*per capita*) properties established during the Roman Age, and the Greek *kata stikhon*, literally, "down the line," in the sense of the directions and distances marked by monuments along the boundaries of a property.



ping ownership rights. Although it is difficult to define precisely when a cadastre was set up for the first time as a public institution, references go back to as early as 3000 B.C. in Egypt, for the management of agricultural land rights in the Nile Valley.

The concept of the cadastre, as applied to mineral resources, has evolved over time. When mineral rights were first included in a cadastre is not known, but the concept was introduced and spread around the Mediterranean Basin by the Phoenicians, and by 500 B.C. an early version of today's mining cadastres was already operating in Greece, distributing mining royalties among the citizens of Athens (further details on the historical evolution of mining cadastres are included in Annex I).

While use of the term *cadastre* is sometimes restricted to the list of mining properties (the registry) or to graphic representations of the mineral rights (cadastral maps), it is now widely used in most mining countries to refer to public institutions responsible for cadastral activities. This latter definition is the one used in this document. An MRC is defined as an administrative entity that is exclusively responsible for the administration of applications and granted mineral rights, as well as for the maintenance of the cadastre registries and control of the timing and validity of the granted licenses.

C. Structure of this Document

In this publication, mining cadastre experiences and rules are examined in depth, with case studies and good practice examples. This document is divided into three main parts:

- *Mineral rights management and the MRC.* Chapter III introduces mineral rights management through cadastres and discusses options and good practices for designing and establishing systems. The chapter covers concepts and principles for mineral rights management, including a discussion of the conceptual basis for mineral rights management as well as the main principles that should be adhered to in order to ensure effective management and MRC functioning. The final section of this chapter discusses information technology for mineral rights management, focusing on good practices for the creation and implementation of a computerized cadastre system (CCS).
- *Issues, options, and alternatives for mineral rights management.* Chapter IV looks at several specific challenges that an MRC may face in its daily administration and management of mineral rights, and offers recommendations for good practices to address these challenges, based on international experiences and lessons learned. The chapter reviews the pros and cons of alternative approaches for granting mineral rights—including the first-come, first-served method and auctioning—and looks at a variety of options for preventing speculative practices and avoiding situations where mineral licenses lie dormant, including escalating fees, relinquishment requirements, and minimum investment or work requirements.
- *Case studies.* The final part of this document (Chapter V) presents a series of brief case studies of mineral sector reform experiences in eight countries. Most of these case studies were guided by World Bank technical assistance projects. Each example looks at the background of mining sector reform in that particular country, legal and institutional issues, the approach to reform, the results of reform, and areas for further development. These case studies offer real-world examples of the analysis and good practices presented in this document.

D. Generalized Mining Sequence

The role and functions of an MRC are integral to what has been called the “mining sequence.” Such a sequence is illustrated in Table 1. As a rule, the MRC intervenes at three different stages (mostly driven and funded by private investors): exploration, transition to exploitation, and closure.

T	Stage	Activity	Government Approval	Cost Estimate	Typical Duration
↓	GEOLOGICAL INFRASTRUCTURE	Regional airborne geophysics, geochemistry and geological surveys		10 to 100 USD/km ²	10 to 20 years, national program cycles
	MINERAL RESOURCES ASSESSMENT	Regional data integration, ore deposit modeling, prospectivity assessment			10 to 20 years, national program cycles
	RECONNAISSANCE	Semi-regional airborne and ground surveys to identify targets		0.5 to 2 million USD	1 to 3 years
	EXPLORATION	Trenching, ground geophysics, detailed geochemistry and geology, drilling	Exploration license; Exploration ESIA	0.1 to 50 million USD	1 to 10 years
	ADVANCED EXPLORATION	Drilling, pilot tests, pre-feasibility study			
	MINE PLANNING	Feasibility and engineering studies, ESIA and ESMP	Mining license; ESIA and others (e.g. water)	0.5 to 10 million USD	1 to 3 years
	CONSTRUCTION	Infrastructure, mine development, processing facilities		50 million to 5 billion USD	
	MINING	Ore production (open pit, underground or alluvial)			10 to 100 years
	CLOSURE	Final closure and decommissioning	Release of license	1 to 50 million USD	1 to 5 years
	POST-CLOSURE	Maintenance		0.1 to 0.5 million USD/yr	Perpetuity

Source: Concept identified by Dr. R. Anthony Hodge, president, International Council on Mining and Metals (ICMM).

Note: ESMP = environmental and social management plan; ESIA = environmental and social impact assessment



III. Mineral Rights Management and the Mineral Rights Cadastre



A. Mineral Rights Management—Concepts and Principles

I. Legal framework and background

The legal basis for mineral exploration, development, and production is typically established in a country's constitution. Normally, sector laws are approved at the parliamentary level. Other provisions, such as those that may need periodic adjustments (such as technical requirements, administrative procedures, and administrative fees), are typically set in regulations or decrees. The sector laws and related regulatory framework will be most effective if they reflect the government's key policy decisions. A well-defined sector law usually includes language on the role of the state, security of title, freedom to operate on a commercial basis, access to mineral resources, comprehensive social and environmental protection requirements, and competitive fiscal terms.

Depending on their particular legal system, governments grant mineral exploration and mining rights to particular areas by means of concessions, leases, licenses, or agreements. Efficient and effective granting procedures tend to be based on the following principles:

- A clear legal and regulatory framework
- Well-defined institutional responsibilities
- Transparent and nondiscretionary procedures

Several core principles have been integrated into the legislation of most mining countries. These principles are as follows:

- Mineral resources belong to the state.
- The right to explore and exploit these mineral resources may be temporarily transferred to an individual or corporate entity through a written document, normally called a license or lease.
- The mineral rights granted through such a license or lease are considered real estate properties, but are independent from surface or land ownership rights.⁵
- The granted license or lease usually does not provide for visible physical boundaries (such as fencing); instead, the area is usually delimited by geographic references or coordinates.
- The holders of the granted license or lease must fulfill pre-established conditions to maintain their rights over the area.
- When the validity of the granted license or lease ends, the rights return to the state.
- *Security of title.* The license or the mineral right cannot be suspended or revoked except on specific grounds, which must be objective and not discretionary, and which must be clearly specified and detailed in the legal framework.
- *Exploration licenses* are granted either by auction or on a first-come, first served basis—which means that the first individual or company to apply for the rights to a certain area where the presence of mineral resources has been inferred will have the priority right to a license or lease.

⁵ This is a generally, though not universally, accepted principle. In some places, such as several states in the United States, mineral rights belong to the landowner.

- *Security of tenure.* In most countries, mineral rights are divided into exploration and mining (or exploitation) licenses. Exploration licenses give holders the right to explore and evaluate the economic exploitation of any mineral resources that potentially exist within the granted area. If an economic resource is confirmed, access normally requires that the exploration license be converted into a mining license. It is during this transition from one stage to the next that problems may arise, especially if any decisions are subjective or discretionary (see Table 1).

Addressing the security of tenure is important; it is difficult to attract investments for mineral exploration if there is a risk that the discoverer of ore deposits will not receive exploitation rights and will thus not recover his or her capital investments.

For this reason, one of the fundamental priorities for investors is to be guaranteed access to exploit any discovered minerals ("discoverer rights"). This is normally provided through the legal and regulatory framework, where the ability to trade prospecting or exploration rights for a mining license is guaranteed. In some cases, this transfer may be conditioned on the completion of certain technical and economic conditions, which should be predefined in such a way that anyone fulfilling the eligibility conditions is guaranteed secure rights.⁶

In order to fully ensure discoverer's rights, three additional principles should be established in the legal and regulatory framework:

- *The exclusive rights of titleholders to any mineral discovered inside the license.* In some countries, for example Mauritania, holders can apply for (and be granted) overlapping exploration licenses, with each license valid for a different mineral substance or a group of substances. In other words, the titleholder's rights are not exclusive, because a license to the same piece of land can be granted several times, although for different substances. While the idea behind this practice is to promote simultaneous exploration for different types of minerals, in practical terms it presents serious difficulties, because two or more minerals are frequently present in the same deposit or hosted in the same rock, making separate exploitation impossible. The deposits of uranium and gold found together in the Witwatersrand district of South Africa is one of the best-known examples of such a case.

For this reason, in countries where an overlap is allowed in exploration licenses, it is prohibited for mining licenses. Only the first holder (from among several overlapped licenses) asking for the transformation of a license from exploration to mining has the right to be granted a mining license. This implies important risks for the titleholders of such overlapping leases, because the basic principles of discoverer rights are not respected, thus affecting the security of tenure.

- *The exclusivity of exploration and exploitation licenses.* In addition, from a technical point of view, it is not proven that overlapping licenses for different substances actually encourage diversified and wider exploration. Modern exploration techniques based on multi-elemental geochemistry, geophysics, and drilling are able to detect many types of ore, but they are expensive and cannot be applied if the holder does not have a guarantee of access to exploitation rights. Consequently,

⁶ By granting a single license for both exploration and exploitation, Peru provides perhaps the greatest security for holders under its single concession system, which avoids the transformation procedure from the exploration license to the mining license and absolutely guarantees the rights of the discoverer. But this automatic transition still does not confer the right to start mining operations without approval of exploitation and related environmental and social plans.

practical experience demonstrates that the real effects of permitting overlapping licenses are contrary to its aims, and allowing overlaps may actually generate conflicts between holders and discourage investments. For these reasons, it is recommended that both exploration and exploitation licenses be exclusive to a single titleholder in any given area.

- *Duration of exploitation/mining rights.* It is important to ensure that exploitation/mining rights are given for a sufficiently long period of time and can be renewed. As a rule, mining rights (including exploitation rights) are granted for periods of up to 25–50 years and are usually renewable one or several times. The termination of a mining right at the end of an arbitrary period may have unintended negative consequences (for example, discouraging reinvestment and forcing mine closure even when a deposit can still be economically exploited). While permit renewals also address the concern of the continuity of operation, they may discourage development in accordance with the geological potential—unless adequate renewal terms are granted. Some countries do not have terms for mining rights; they last for as long as the holder continues to comply with the applicable maintenance requirements. In most cases, this requirement is equivalent to the payment of an annual fee.

In practical terms, the interpretation and implementation of these principles varies from one country to another; based on the form of government, political context, local traditions, and cultural heritage.

There are two substantial differences between the type of rights granted through mineral licenses or leases and other standard property rights, such as ownership of land or buildings. First, rights over mineral resources are granted only temporarily, and after the license or lease expires, they revert to the state. This principle has been generally accepted into the legal framework of most mining countries.

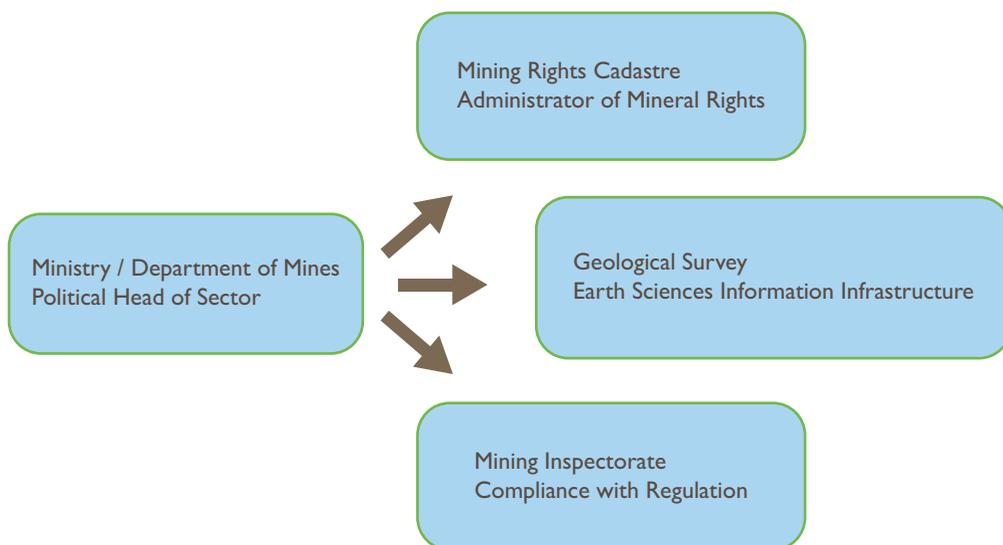
Second, although mineral licenses or leases are considered real estate properties, they do not carry the same rights as other real properties. As a rule, titleholders must fulfill preestablished conditions in order to be granted rights and maintain them and (often) transfer or mortgage those rights.

2. Institutional framework for an MRC

The main functions of public mineral institutions (PMIs) include: (i) definition of sector policy, goals, and strategies; (ii) establishment of the legal and fiscal framework, including the definition of regulations and procedures; (iii) administration and monitoring of compliance with all laws, regulations, and procedures; and (iv) establishment of databases and accessible websites containing reliable technical information for monitoring sector performance, land use management, and sector promotion, as well as to guarantee transparency in sector management.

See Figure 2 for a list of common management entities in the sector (and their function).

Figure 2. Generalized Organizational Structure of a PMI



- *The of Ministry of Mines (MM)* acts as the political head of the sector. The MM is responsible for mining policy and definition of laws and regulations; coordination with other ministries; supervision of the mining sector agencies/offices responsible for implementing policy and compliance with regulations; compilation and publication of statistical data; and promotion of mining activities and investment opportunities.
- *The Mineral Rights Cadastre (MRC)*, as a public sector entity, receives applications and issues and administers mineral rights.
- *The Geological Survey (GS)* develops and maintains reliable national earth science infrastructure, including geological maps and related databases. The GS provides the basic geological knowledge for the mineral industry and other needs such as water resource management, environmental management, land use, geo-hazards risk management, and infrastructure works.
- *The Mines Inspectorate (MI)* monitors mining operations and ensures compliance with laws, regulations, and procedures related mostly to environmental, social, health, and safety issues.

From an institutional perspective, the MRC is a key management system for accessing mineral resources and monitoring sector performance.⁷ The establishment of a public register and the application of nondiscretionary, consistent procedures as part of the MRC are critical to ensure transparency in the granting of mineral rights, to guarantee the security of tenure, and to facilitate the management of competing land uses (for example, mining versus protected areas). See Annex 2 for more information on the suggested internal organization of an MRC.

⁷ The use of the term *mineral rights cadastre* instead of *mining cadastre* is suggested to avoid possible confusion between the Latin-derived meaning of cadastre (which includes exploration and exploitation activities) and the English-language meaning, which is limited to exploitation only.

3. Mandate and functions

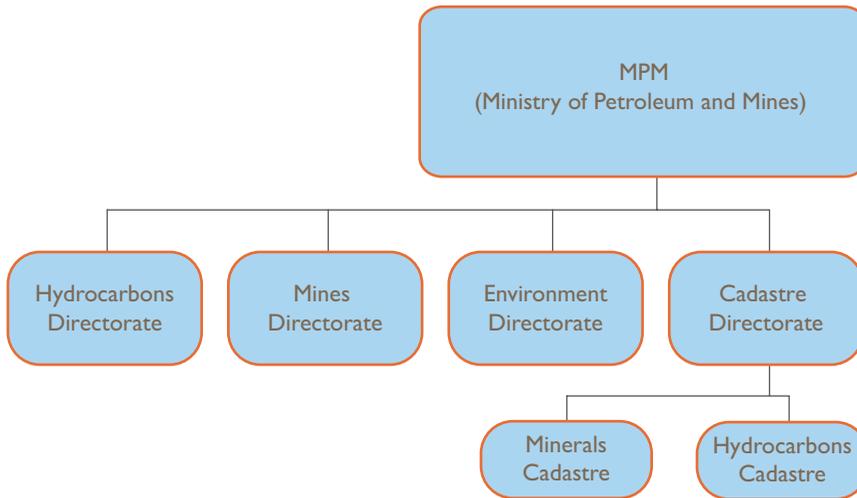
As the agency responsible for the administration of mineral rights, the MRC is responsible for:

- Acting as a liaison between the state (represented by the ministry responsible for mines) and the holders or applicants on any question related to mineral rights; this interaction includes written notifications, which should be centralized in the MRC
- Receiving applications for new licenses, as well as requests for renewal, extension, reduction, transfer, and abandonment
- Chronologically recording new applications in an official register
- Producing updated cadastral maps on which existing mineral rights, pending applications, and areas restricted for mining activities are correctly plotted
- Verifying that licenses do not overlap (especially in the case of new applications), checking the eligibility of applicants, and making decisions to grant or refuse applications
- Keeping cadastral maps and registries open and accessible for public consultation
- Initiating procedures for the revocation, cancellation, or expiration of licenses in accordance with the provisions of mining laws and regulations
- Acting as a technical referee in the event of dissension between holders about the location of areas granted and resolving any disputes resulting from the definition and demarcation of markers and boundary lines of areas subject to mineral licenses
- Collecting administrative fees required for the submission of mineral rights applications, as well as annual rental fees from valid licenses

The responsibilities and functions listed above involve all types of mineral rights, from reconnaissance and exploration to mining. In some countries, in addition to these license types, special licenses have been introduced for small-scale and artisanal mining, gemstone mining, or building material mining (quarries). In general, all of these are included in the general mining regime and subject to the cadastral regime. Practical experience demonstrates that keeping these special types of mining activity outside of the general mining regime can cause problems. Thus, it is recommended that management of all mining activity be unified and centralized under the responsibility of a single organization that includes specialized agencies or departments, one of which should be responsible for the cadastral management of the mineral rights. This organization should be in charge of applying a unified set of legislation, regulations, and rules to all mining activities. The more accessible the information is to the public, the less channels of corruption will remain open.

Another important consideration is the relationship between mineral rights and hydrocarbons. In most countries, solid hydrocarbons such as coal or bitumen schist are regulated under mineral legislation, because the exploitation techniques for these products are similar to those of other minerals. On the other hand, nonsolid hydrocarbons (oil and gas) are generally regulated under a separate regime, with different rules for granting rights. As a result, oil and gas would be excluded from the MRC. An exception is the institutional structure adopted in Mauritania, where, until recently, a single directorate hosted both minerals and hydrocarbons cadastres. The two organizations worked as separate units and followed different rules, but shared common infrastructure such as topographic and geodetic information, global positioning system (GPS) field equipment, databases, and geographic information system (GIS) tools (see Figure 3).

Figure 3. Structural Organization of the Ministry Responsible for Mines in Mauritania (until August 2008)



4. Interinstitutional position

The location of the centralized cadastral management unit of all mining activity within the government is often discussed. There are three prerequisites that must be considered:

- In order to guarantee coordination between the cadastral activity and the other agencies focused on geological infrastructure (the GS), control (the mining inspectorate), or environmental monitoring, the MRC should be linked to the ministry or institution that is responsible for the management of the mining sector.
- In order to avoid technical interference and unnecessary operational interactions, the MRC should be hierarchically independent from the GS, mining inspectorate or environmental monitoring agencies, regardless of the need for coordination. All agencies responsible for the management of the mining sector should have complementary and well-differentiated functions. Therefore, they should be coordinated or linked with the same ministry, while still maintaining their operational autonomy.
- In addition, the MRC should be completely independent from any state entity authorized to hold, explore, develop, operate, or dispose of mining properties, in order to avoid any conflict of interest and to guarantee objectivity, transparency, equity, and fairness in decisions affecting the granting of mineral rights.

5. Decentralization

Decentralization of administration and state management is a global trend today, aimed at increasing the quality and speed of services provided to citizens throughout all areas of government. The mining sector is no exception and the decentralization of the mining cadastre, particularly in large countries with remote mining areas, is necessary for effective management of the sector. Decentralization, however, can bring risks of conflict, duplication, and overlapping unless certain rules are followed. Computer tools and the internet can be useful for managing a decentralized cadastre, but experience shows that these alone will not be enough without the creation of adequate organizational structures and procedures.

B. Implementation Principles for Effective Mineral Rights Management

As mentioned above, cadastre principles were created along with those governing private property to establish taxation units and to transmit security of ownership to titleholders. Both types are still valid, and the MRC must focus on protecting and guaranteeing the rights of both the state and the titleholders.

To achieve this balance, it is essential for the MRC to make transparent, objective, and nondiscretionary decisions.

I. Transparency

Transparency in cadastral management should be ensured for both cadastral procedures and information. To guarantee the transparency of cadastral procedures, the legal and regulatory framework should include:

- Explicit, simplified, and detailed requirements and procedures for obtaining, maintaining, and terminating mineral rights. Any holder, applicant, or interested individual or corporation must be able to access detailed information about the requirements and conditions of applying for mineral rights—and the validity of granted licenses. In this respect, it is extremely important to predefine eligibility conditions without ambiguity and based on simple and objective criteria.
- Requirements that applications for new mineral rights be registered in a specific book or database, with the exact date, hour, and minute of application.
- Deadlines for specific timeframes within which applicants, titleholders, and cadastre agents are required to take certain actions or make certain decisions; for instance, related to the maximum duration of granting procedures (counted from the application date) or the maximum time before expiration when a holder can apply for the renewal of a license.
- Requirements for written notification of any decision affecting applications or existing grants of mineral rights, followed by an opportunity to be heard before any significant action affecting solicited or acquired rights is taken. For instance, if the application for a new license has a mistake, the applicant must have the right to correct the error (within the predetermined deadline) before the application can be rejected. Related to this, it is very important that the legal framework and cadastral procedures determine the minimum required conditions for an application to be accepted by the MRC.

- Stipulations guaranteeing the opportunity for administrative (if appropriate) and judicial review of decisions affecting solicited or acquired rights.

To guarantee the transparency of cadastral information, the MRC office should be open for consultation, and the cadastral maps and registries (at least the part considered “public”) should be accessible to applicants and license holders. At a minimum, the following types of information should be made available to the public:

- The cartographic position of granted mineral rights as well as any pending applications
- The cartographic position of areas where mining activity is restricted or prohibited
- The registry book for verification of license application, sequence, and chronology
- Relevant cadastral information about any granted or applied mineral right, including, at minimum, the application date, name of the applicant, applied-for or granted mineral substances, and expiration date (in the case of licenses already granted)

It is impossible to establish and effectively manage an MRC without transparency. Furthermore, international experience shows that lack of transparency is one of the most significant sources of corruption. During the last few years, many countries have taken advantage of available technology to disseminate cadastral information through the internet on public websites. This practice helps ensure that all potentially marketable data are freely accessible, thus eliminating any type of black market for “confidential” information.

2. No subjectivity in evaluation criteria

This principle implies the removal or minimization of subjective evaluation criteria as preconditions for granting mineral rights. In practical terms, it means that all the criteria and parameters to be considered and evaluated for granting a license must be objective and not subject to interpretation. This avoids the risk of discretion that would arise every time a rule or procedure needs interpretation—and prevents the application of different interpretations to different applicants or holders.

While this principle is easy to state, in some cases it can be difficult to apply. For instance, if the criteria to be considered are strictly technical—for example, verifying that a license does not overlap with others before granting the application, based on the use of mapping techniques—then the related decisions are simple and can be 100 percent objective. Unfortunately, things are not always so simple. For example, in many countries, a fixed precondition for granting a license is that applicants must demonstrate their financial capacity or the availability of an adequate exploration and/or exploitation plan. Such preconditions are well intentioned, but it is very difficult to evaluate such capacity objectively. One potential solution is to regulate detailed criteria for the amount of investment to be expended or where its availability must be demonstrated. In practical terms, however, this solution introduces additional difficulties because these values would need detailed adaptations to each type of project, substance, or process; it is, in fact, very difficult to determine and calculate these prefixed values. The same difficulties arise when officials try to objectively evaluate an exploitation plan; the number of technical variables and parameters to be introduced is so enormous that it is impossible to provide objective criteria for evaluation in the legal texts. The system should guarantee equal conditions for all applicants without discrimination.

So what is the answer to this dilemma? Certainly, any government must have the right to evaluate technical projects before authorizing their implementation and the start of operations, in order to guarantee that the projects meet safety, health, and environment standards. The key question is whether this evaluation should be done before or after the license is granted.

At the end of the twentieth century, some countries tried to eliminate discretion in the implementation of their mining laws by:

- Removing any requirement for a mineral right applicant to demonstrate either the existence of a commercially viable deposit, or the applicant's financial and technical ability to carry out a work program
- Eliminating or standardizing the work, investment and/or production requirements, and the means of satisfying them
- Limiting the grounds and procedures for the cancellation of mineral rights

Although these conditions work well in countries where they have been adopted, they cannot necessarily be directly exported to other geopolitical contexts where traditions, the structure of mining sector, and the general legal framework are very different. These fundamental questions are analyzed in further detail in Chapter IV of this document.

3. Nondiscretionary decisions

A consideration related to discretionary decision making is the existence of “contractual regimes,” which were very common in the past and still exist in some countries. In these cases, the conditions for granting mineral licenses are variable and negotiable, and essential parameters such as the duration of validity or the value of rental fees differ from one license to another. Under certain circumstances, this practice may be attractive; investors are receptive to contractual regimes that provide good security of title and fiscal and foreign exchange stability without lengthy and difficult negotiations. But, while contractual regimes are appropriate in some cases, it is best to avoid case-by-case negotiations that are discretionary, lack transparency, and can be a source of corruption.

Avoiding discretionary decision making can be achieved by predetermining the legal and regulatory framework and the standardized conditions for the granting of mineral licenses (duration, size, geometry, fees, conditions for renewal, and so on). Based on these legal provisions, the MRC should ensure that standard principles are applied to any type of applicant and holder.

C. The Geometry of Mineral Rights

In addition to determining the proper implementation principles and institutional framework, efficient and effective operation of an MRC also requires a minimum level of technical capacity and infrastructure. One of the essential activities of the MRC is to fix and delimitate the position of mineral rights, which do not have visible physical boundaries. This requires the effective and knowledgeable use of cartographic and geodetic techniques.

In many countries, the lack of adequate topographic map coverage and/or a developed geodetic points network has led to the inaccurate positioning of licenses and frequent conflicts, resulting in the insecure tenure of title holders. Currently available

technology, including satellite images the GPS and GIS tools can help compensate for these deficiencies, but these techniques must be clearly applied to avoid positioning mistakes (for instance, by mixing projection systems).

The official document used for positioning the mineral rights in any country is the official cartographic map produced by the national GS or the equivalent entity. Consequently, the MRC should exclusively use the types of coordinates and the parameters (projection system, geoids, and so on) that have been used to produce that national map. In practical terms, this means that if the MRC is using GPS technology, for example, the obtained coordinates should be transformed into the national map equivalents and not the reverse. It also means that, in the case of a contradiction between the field topographical or GPS data or the GPS data and the national map coordinates ("cadastral coordinates"), the cadastral coordinates should take priority.

This subsection presents the good practices and solutions that have been adopted to address the challenges of positioning mineral rights, based on international experiences from the past several decades.

1. The cadastral unit (CU) concept

One of the most innovative and efficient concepts introduced in the management of mineral rights is the cadastral unit (CU). A CU is a quadrangular polygon with constant (or pseudo-constant, depending on the type of projection used) dimensions that is referred to and has a fixed position within a system of coordinates. The definition of a CU should be included in any legal framework, and cadastral procedures should provide technical details about the delimitation of mineral licenses.

Before the CU concept was developed, many countries had no restrictions on the shape, geometry, and position of mineral rights, leading to a number of problems, including frequent overlaps between adjacent concessions and the presence of areas (depending on the rules of each country) that were geometrically blocked for applications. The concept of a CU has been successfully introduced around the world under various names, including the *cuadrícula* in Bolivia and Peru; the *carré* in Madagascar, Mauritania, and the Democratic Republic of the Congo (DRC); the *bloco* in Mozambique; and new CUs currently being adopted in Mongolia, Nigeria, Zambia, and many other countries.

The evolution of a modern CU began with restrictions on the geometry and positioning of mineral rights that began appearing around the world as soon as the first modern topographical maps were available, at the end of the 19th and beginning of the 20th century. These restrictions required the borders of the surface areas of mineral licenses and mining rights to be polygonal, regular, and parallel to the coordinate system used in national maps (see Figure 4).

These conditions were soon expanded to include requirements that polygons should have *minimum* dimensions. The minimum size of a single mineral rights area would equal the dimensions of the CU; for instance, if a CU were 500 meters x 500 meters, then that would be the minimum area allowed for a license. Any mineral licenses should always be made up of a certain number of CUs; thus the dimensions of the sides of any polygon corresponding to a mining license and mining rights will always be in multiples of a single side of the CU (that is, 500 meters, 1,000 meters, 1,500 meters, 2,000 meters, and so on; see Figure 5).

The final step in the evolution of a modern CU was the requirement that polygons corresponding to mining licenses and mining rights cannot float and be placed anywhere. Rather, they must always be located coherently within a predefined and standard grid (see Figure 6). These grids can be mining specific (exclusively designed for the mining cadastre) and drawn over national maps, as is the case in Bolivia and Peru, or they can be generic, using the standard grid that is usually represented in topographic maps, as in Madagascar, Mauritania, and Mozambique. See Annex 3 for more information on the geometry of mineral rights.

Figure 4. Evolution from Nonrestricted Geometry Rights to Geometry Controlled by Coordinate Systems Used in National Maps

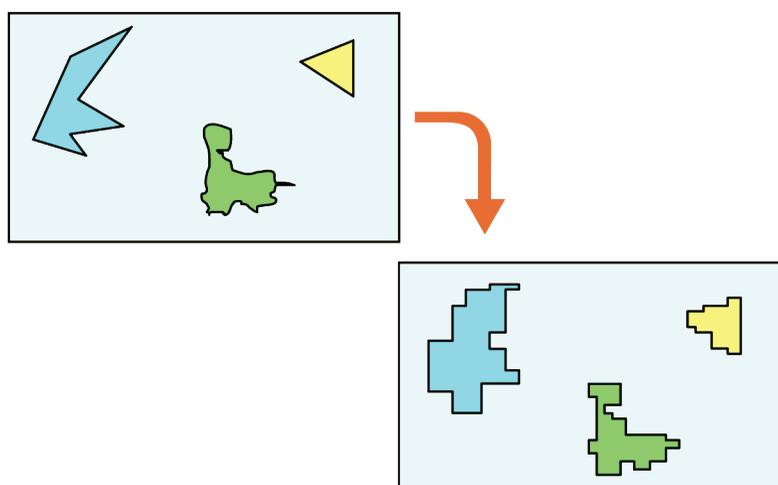


Figure 5. Evolution from “Noncellular” Polygons to the Geometry Controlled by Polygons Made Up of Individual CUs

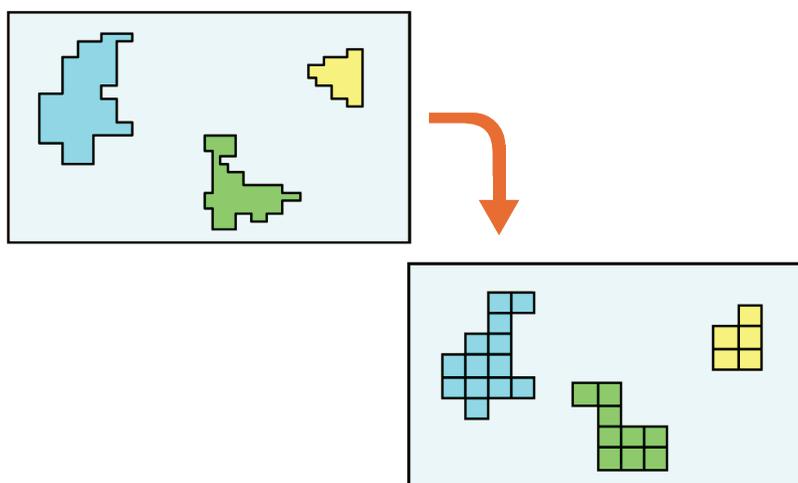
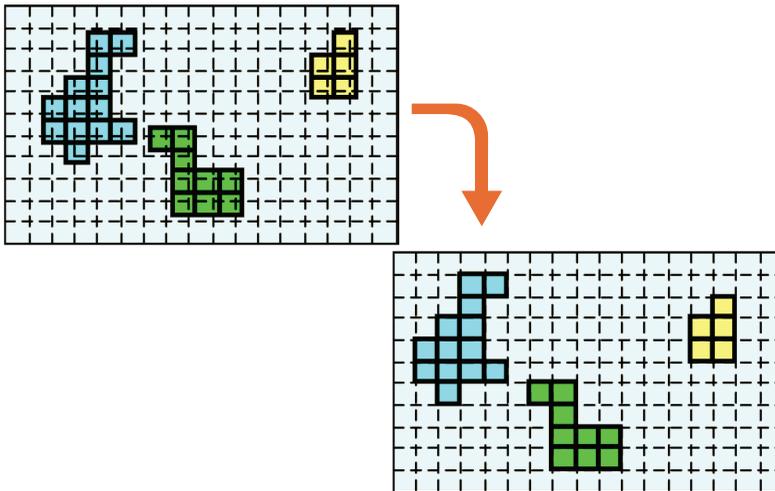


Figure 6. “Prefixed Cellular” Polygons Controlled by a Predefined and Standard Grid



2. The use of GPS technology

GPS is an indispensable tool for the practical application of the CU system, as it is the easiest, fastest, and cheapest way to determine the position of CUs and licenses in the field—whether for applicants, titleholders, or the cadastre administration.

The effective use of GPS technology (for fieldwork in general and mining cadastres in particular) requires that GPS-measured coordinates be correctly plotted over a suitable map. Thus, the applicability of GPS technology in the positioning of the mining licenses and concessions, both for the mining administration and the mining companies, depends on three basic factors:

- The availability of maps with suitable scale and accuracy
- The availability of a geodetic network with suitable accuracy and density
- The availability of transformation parameters that allow the transfer of coordinates and projection system of the GPS to the coordinates of the maps. Without such parameters, the potential for error in transferring the GPS coordinates directly to the maps is very high (in many cases an error of several hundreds of meters has been detected) and unacceptable for the mining cadastre.

These three conditions are normally fulfilled in industrialized countries, but not always in less developed countries, where the third condition is often missing and transformation parameters are not available. These parameters are not the standard transformation algorithm commercially distributed with the GPS devices, which cover just a part of the required corrections. Rather, transforming the GPS-observed coordinates into map coordinates (or vice versa) requires three steps:

- The correction from one type of projection and coordinates to the other; for instance, converting geographical coordinates (degrees, minutes, and seconds) into universal transverse mercator (UTM) coordinates, if required

- The correction from the geoids used by GPS (World Geodetic System [WGS–84] or International Terrestrial Reference Frame [ITRF]) to the geoids utilized in the country maps.⁸
- The correction of the difference between the geodetic network used by the satellite system (space based) and the country’s geodetic network.

While correction of the first two errors is purely mathematical and easily taken care of by commercial software normally supplied with the GPS device, the third is a particular error linked to the country’s geodetic network and cannot be corrected unless specifically verified.

Once the verification of the third parameter has been done (that is, comparison and correction of the satellite system and the country’s geodetic network), the newly established parameters should be officially declared and published. Their utilization must be required in the text of applicable regulations. To facilitate the utilization of these parameters, it is recommended that the MRC provide such parameters for free to applicants and titleholders.

D. Information Technology for Mineral Rights Management

I. Benefits and limitations of computerized cadastre systems

Information technology has helped to facilitate the development of cadastral operations and the management of mineral rights since the early 1990s. Through the adoption of CCSs, mining countries have been able to reinforce their institutional capacity, shorten processing periods for applications, and reduce errors (such as overlaps between adjacent licenses), thus increasing the security of their titleholders’ tenure. These improvements have had the added benefit of improving transparency, minimizing corruption, and eliminating discretion in the implementation of legal and regulatory frameworks.

Despite the value of a CCS, an MRC gets its legitimacy from the legal and regulatory framework supported by paper documents—the only documents with full legal and administrative validity. Thus, cadastral computer tools should be seen principally as management tools, serving to support administrative decisions, facilitate accurate access to the required cadastral information, and make it easier to screen applications and control deadlines, dates, and processes linked to cadastral procedures.

From a practical point of view, there are several important guidelines to be taken into account when designing and implementing a CCS:

- Computers on their own cannot provide solutions for all cadastral troubles. In fact, it is not possible to efficiently computerize a MRC if there is not already a well-organized and systematic “paper” cadastre that includes codification, filing, and procedures. Any existing conceptual mistakes or erroneous design features of the old cadastral procedures will just be inherited (and potentially enhanced) by the digital system

⁸ As identified in Hayford, Krakowski, Bessel and Clark, 1880.

- Although it might be technically feasible, the CCS should not be programmed to make decisions or take action on its own (for example annulling a license if the expiration date has passed without renewal). The system should be set up only to remind cadastral agents of actions that need to be taken.
- The computerized cadastre operations and routines should be absolutely consistent with the law, regulations, and cadastral procedures. Furthermore, the digital cadastral files should contain exactly the same information as is registered in the paper cadastral documents.
- Although there are commercially available products that can be integrated into the CCS, there is no single software that can be applied directly in any country without redesign or adaptation. A CCS should be designed and implemented to fit the particular legislative and regulatory framework of each individual country.

2. Technical characteristics and required functionalities

From a technical point of view, a CCS is a computing application that integrates GIS software, database management software, and specific cadastral routines linked to the legal framework and cadastral procedures. The hardware configuration and capacity of software to be integrated will depend on the cadastre size (number of mineral rights to be managed) and the complexity of the legal and regulatory framework in each country. Regardless of the scale and local characteristics, however, there are several general features that should be part of any CCS, related to graphical capacity, operational and functional characteristics, and technical sustainability and compatibility.



3. The transition to computerization

The implementation of a CCS will involve a transition from standard paper files and analog-based methodology to digital methodology. As noted above, it will not be possible to computerize a cadastre if a well-organized and systematic paper system does not already exist.

Even if the system is already well run on paper, there are several challenges that may arise during the transition to computerization. Often, the system used for codification and filing on paper is not valid in a digital system, where each license must have a single and unique identifier. For this reason, the introduction of a new codification system and the recoding of all documents may be required. Furthermore, the digital system cannot be introduced in a single day; the migration from one system to the other should be done gradually, in order to guarantee the existing mineral rights and status of registered applications, and minimize risks for titleholders and the administration.

4. Computerization and decentralized cadastres

Decentralizing the MRC can be very effective, particularly in large countries where the mining areas are far away from the administrative capital city or where communication is difficult. Decentralized offices can provide updated information on mining areas and applications to titleholders, applicants, and other interested parties; receive and register applications for mineral rights, either by specific zone or for the whole country; and grant some types of licenses, normally only for small-scale mining or preliminary exploration.

These services can all be extremely useful for titleholders and applicants, enabling them to avoid lengthy and sometimes unaffordable trips to the capital city and allowing for the normalization of many irregular mining activities. But they can also pose serious risks of conflict if information is not effectively shared across the various offices. Effective communication throughout the various parts of the cadastre requires a minimum technical infrastructure for data transfer and interaction between the central and decentralized offices. Without such infrastructure, cadastral decentralization will not be successful.

5. The value of computerization for improving cadastral management

Practical experiences around the world have shown that computing tools have greatly facilitated cadastral management by reinforcing institutional capacity and increasing the security of titleholders' tenure through increased transparency in cadastral information and procedures. The benefits of a CCS include:

- A significant decrease in the time required to assess cadastral dossiers, allowing applicants and titleholders to avoid long and potentially costly waiting periods between application and cadastral decisions. In the case of renewals or transformations from exploration licenses into exploitation licenses, shorter waiting times mean a significant increase in the security of tenure.
- Minimization (or even elimination) of cadastral mistakes linked to mineral rights geometry or positioning, as well as conflicts related to overlaps between adjacent licenses. A computerized system allows early detection of these errors and can correct them before titles are granted, contributing even more to the security of tenure for mineral rights.

- Prevention of the manipulation or violation of cadastral procedures, ensuring the correct application of legal provisions, a decrease in opportunities for discretion and corruption, and, consequently, a further increase in security of tenure.
- Instantaneous access for applicants and titleholders to updated cadastral information, including the most recent applications. This helps to avoid misunderstandings and conflict over which areas are vacant or occupied, increases transparency, and minimizes possibilities for corruption. Similar benefits result from the dissemination of digital cadastral information through the internet, further increasing the security of tenure.
- Increased efficiency in the automatic generation of statistical products, which facilitates analysis of the state of the mineral rights sector, cadastral management, and the impacts of mineral resources policy. Based on the information generated automatically by their CCSs (among other sources), countries such as Algeria are developing computerized instrument panels to monitor the behavior and performance of the entire mineral sector; based on technical, economic, environmental, and social factors.

Because of the vast benefits of a CCS, it would not be conceivable today to implement a new cadastral methodology without the support of a computer system. But it is important to remember that computers by themselves cannot provide solutions for all cadastral problems; computerization will provide the advantages listed above only if the legal and regulatory framework, the cadastral procedures, and the document management methodology are properly implemented. In some countries, despite the availability of powerful and adequate computing tools, the lack of adequate cadastral regulations, cadastral procedures, MRC organization, and cadastral methodology can negate any possible benefits of the computerization of cadastral management. In some cases, although the principles enunciated in the mining law may be considered valid, the lack of regulations supporting such principles (and the consequent lack of cadastral procedures) can also cancel out any positive benefits of computerization. The present status of the cadastres in Ghana and Zambia are examples of the latter case, where the procedures and regulations were introduced after the cadastre was set up.

See Annex IV for more details on the design, implementation, and benefits of a CCS.



IV. Issues, Options, and Alternatives for Mineral Rights Management



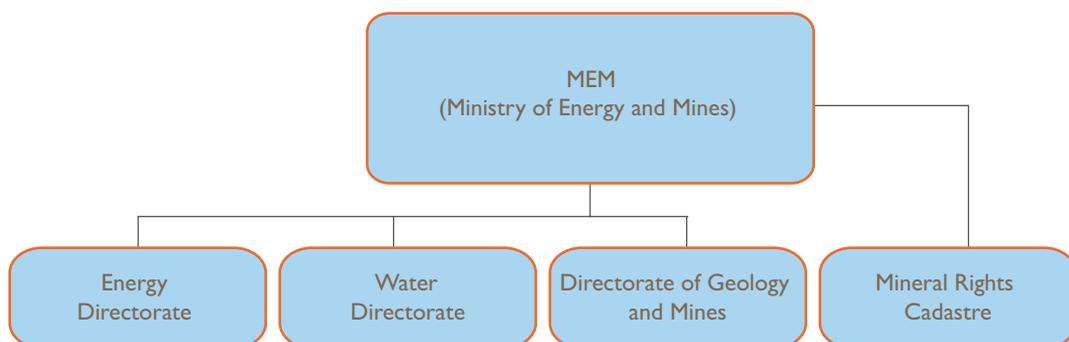
Chapter III of this document addressed the legal, conceptual, and functional principles that have emerged as international good practices for establishing a modern and efficient MRC. This chapter will be devoted to an analysis of various alternative options that have been selected in different countries for mineral rights management and the practical consequences of these choices.

A. Institutional Frameworks and Their Organizational Aspects

To address the challenges of managing mineral rights, countries around the world have adopted a variety of different organizational solutions for their respective MRCs. In some countries, the cadastre agency is an independent department inside the ministry or the state institution responsible for the mining sector (for example, Mongolia). In other countries, such as Madagascar, the MRC is an agency external to the organization of the ministry but reporting directly to the minister (see Figure 7). In each of these cases, the granting regime is defined as “administrative.”

In still other countries, the desire to ensure maximum institutional transparency and to avoid the concentration of decision-making power inside a single ministry has led to a split in cadastral management between two different ministries. For example, in Chile, procedures for the granting of mineral rights are developed and overseen by both the MM and the Ministry of Justice. Such regimes are defined as “adjudicative.”

Figure 7. Organization of the Ministry Responsible for Mines in Madagascar



In general, administrative regimes tend to be more responsive to policy changes and are easier to manage than adjudicative regimes. Nevertheless, adjudicative regimes are attractive, because they are authorized to grant and extinguish mineral rights completely independent of any state mining interests. Although the procedures of adjudicative systems tend to be transparent and accountable, they require a strong and independent judiciary—a condition that is not always present in all countries. Furthermore, the adversarial and litigious character of an adjudicative system may be perceived as detrimen-

tal to providing adequate security of title. In Chile, where the adjudicative procedures provide adequate security of title, the process of litigating and defending mineral rights is perceived by some industry executives as costly and time consuming. In addition, despite their overall effectiveness, the two types of cadastral offices—the technical offices (one in each region with significant mining activity) and the administrative offices located in the courts (120 offices; 1 per district, uniformly distributed throughout the country)—have had some negative impacts. For example, because the administrative offices are standard court offices and not specific to the mining sector:

- Boundary conflicts may arise between adjacent licenses located along district borders because there is no interaction or communication among courts to prioritize among applications overlapping two or more districts.
- The centralized mining administration is informed by the courts about newly granted licenses in a timely manner, but no information is shared about the number of applications currently being evaluated or waiting for the granting of mineral rights. This situation makes both short- and long-term planning difficult.

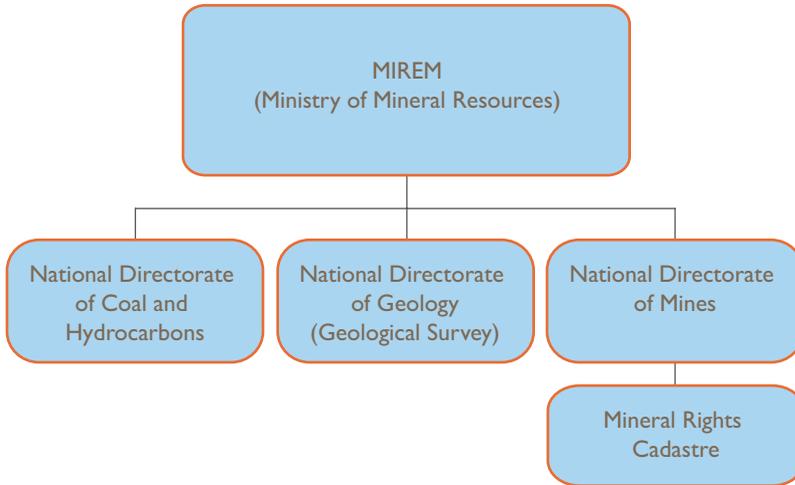
In spite of these challenges, the Chilean MRC experience has been positive and is well appreciated by investors, who consider it one of the more reliable systems in the world. But applying exactly the same organizational model to other countries where circumstances are different or where cadastral rules are not applied with the same consistency, may result in a different outcome. This has been the case in some states in Argentina, where cadastral responsibilities are equally shared between the mines and justice ministries, and where various cadastral irregularities (mainly due to a lack of strictness and rigor in the application of cadastral procedures) were detected and corrected several years ago.

Mozambique is an example of a nation where the structure does not meet all of the recommended prerequisites for positioning within the government yet still has resulted in an acceptable outcome. In Mozambique, there is an organizational mixture between the cadastral and inspectorate agencies (see Figure 8). In other words, the MRC is positioned directly inside the Directorate of Mines.

Thus, experience has shown that the effectiveness of an MRC depends less on following some predefined organizational model and more on respecting the principles discussed in Chapter III. In the case of Argentina's states, the lack of transparency and rigor in the cadastral procedures could not be overcome by the adoption of the same organizational model that is being used with excellent results in Chile. In the case of Mozambique, although the cadastre and the inspectorate are operating under the same directorate, they can still work with enough autonomy, avoiding mutual interferences, so that the results are satisfactory. Independent of the type of organizational model adopted, it is important to ensure that it is clear and effectively structured in order to restrict (or at least minimize) undesirable maneuvers.

It is therefore inadvisable to recommend one system as superior to another; each has produced excellent results in some countries while proving problematic in others. An operational solution that has been successful in one country will not necessarily work exactly the same in another, and will need to be adapted to the characteristics of that particular country to guarantee effectiveness.

Figure 8. Organization of the Ministry Responsible for Mines in Mozambique



B. Decentralization

While decentralizing the mining cadastre may increase the efficacy of sector management, the process can also carry risks that should be carefully analyzed and managed before decentralization is completed. For example, the separation of roles between central and decentralized offices is often not clearly delineated, leading to serious ambiguities, lack of coordination, and inconsistencies in the cadastre activity. If, for instance, all offices—both central and decentralized—are receiving and registering applications and granting licenses without any interaction or clearance at the central office, the immediate result will be overlapping and conflicting licenses, leading to a sharp decrease in the security of tenure and an increase in risks for applicants and titleholders, making the country far less attractive to investors.

Another problem found when coordination between the central and decentralized offices is not effective is a lack of consistency in the interpretation and application of cadastral rules, especially in the decentralized offices, which may start to follow their own interpretations of legal texts—leading to significant disparities from one office to the next. This heterogeneity is not only an administrative irregularity, but also another increased risk factor for investors, because lack of homogeneous and uniform rules for the whole country may transmit the image of an unstable and ineffective minerals management system. In order to avoid such problems, an effective organizational model should be adopted, including a clear definition (preferably fixed in the legal and regulatory framework) of the role, functions, and responsibilities of both central and decentralized offices, as well as the cadastral procedures to be applied in each. In addition, an effective system of technology and practices for data transfer and interaction between the central and decentralized offices should be implemented.

A wide variety of effective models for the functional and organizational structure of decentralized cadastre offices has been adopted. The easiest and most effective models are based on a simple division of work between the central and decentralized offices:

- The *central office* should be responsible for coordination (including control of the chronological order for new applications) of cadastral activity, with jurisdiction for processing applications and making decisions on grants over the whole country.
- The *decentralized offices* should be responsible only for receiving and registering applications for mineral rights, with each office responsible only for those applications that correspond exclusively to the geographic domain under its jurisdiction.

This simple model can be increased in complexity by adding complementary responsibilities to the decentralized offices, such as the reception of applications corresponding to areas under the jurisdiction of other offices, or even delegated authority for granting some types of licenses. Decentralized offices are, however, given more responsibilities, which in turn requires stricter controls to avoid conflict and guarantee transparency. In practical terms, the structure should always be seen as a single cadastre with several offices, rather than as several cadastres.

Before any application is registered, it should be assigned a unique code given by the central office—a system that offers significant protection for those served on a first-come, first-served basis. In addition, any cadastral analysis to determine if licenses or applications overlap should be restricted to the central office, meaning that regional offices cannot determine the availability of a specific area or grant licenses (in cases where legislation allows it) without clearance from the central office. Experience has shown that significant conflicts arise in countries that do not respect these basic conditions related to the defined roles of central and decentralized offices. This was the case in the late 1990s in Madagascar and Mozambique, and it is still the case in Nigeria and Zambia. In recent years, countries such as Ecuador and Peru, and more recently Madagascar and Mozambique, have addressed these challenges through the use of technology and the internet to coordinate activities across the central and regional offices.

From a general point of view, a simple model based on this division of tasks is the easiest to implement effectively. Consequently, the addition of complementary complexities is only recommended if there are substantial political or institutional reasons (such as a state decentralization policy) or strong geographical and social arguments (remote areas with important mining activity). In all cases, good access to information technology in both central and decentralized offices is necessary before the adoption of any type of decentralized model.

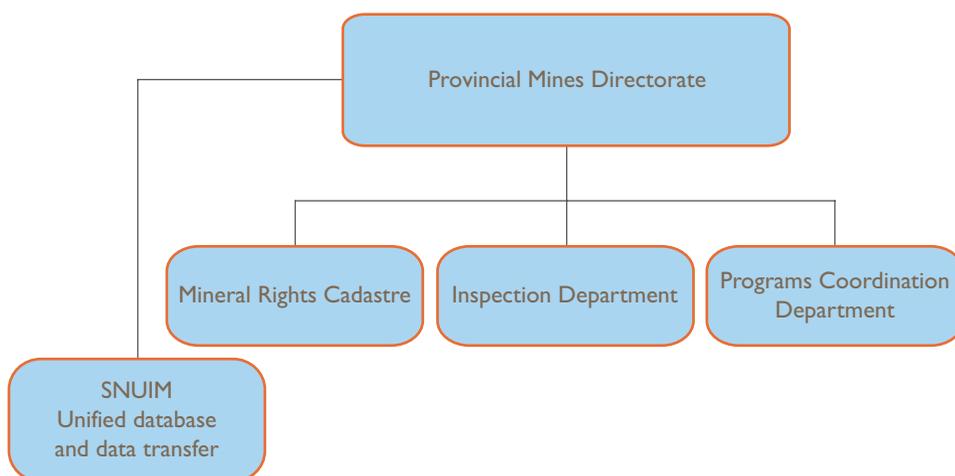
The preceding discussion on decentralized cadastres is relevant only in countries where the authority for granting mineral rights belongs to the central government, which then delegates some of its responsibilities to regional offices or even local governments (as is done for certain types of licenses in Madagascar). Completely different issues arise in cases where the state is a federal institution and granting power belongs, by definition, to states or provinces within the federation. Nevertheless, this institutional situation is not incompatible with a centralized federal coordinating body; in these cases, the main cadastral goal should be to unify and coordinate cadastral activity and procedures among different states or provinces.

This issue may be particularly complex if each state or province has its own constitution, with different mineral laws and even different granting systems. This is the case in Argentina, where some of the provinces are ruled under administrative regimes and others under adjudicative regimes. Nevertheless, during the reform of its mining sector, Argentina succeeded in unifying cadastral procedures with excellent results. Each of Argentina's federal provinces has full autonomy for granting mineral licenses, but

a centralized information system guarantees data transfer and sharing of information among the provinces (see Figure 9).

On the other hand, several other countries, such as Indonesia and the People's Republic of China, have not been able to implement such centralized coordination, leading to serious problems for cadastral management. In the case of Indonesia, the relaxation of central coordination in cadastral activities generated a sharp decrease in exploration investments.

Figure 9. The Generalized Structural Organization of Mineral Rights Management in Provinces in Argentina



The Indonesian mining sector provides an interesting example of the particular challenges that decentralization poses. Indonesia is made up of several hundreds of islands and is one of the countries in the world where the needs for decentralization are the highest.

During the 1980s and 1990s, Indonesia was the most successful country in Asia in terms of attracting foreign investment. It developed a world-class mining sector. Simultaneously, the country implemented an efficient computerized cadastre, one of the more advanced in the world when introduced in the late 1990s. Due to particular political decisions adopted in 2001 and 2002, cadastre management was decentralized and mineral rights licensing responsibilities were transferred to municipalities, leading to a number of problems, including:

- Lack of coordination in the implementation of the legal framework and cadastral procedures, which varied from one office to another
- Lack of homogeneity and coordination in the codification system, which differed across offices, making simultaneous and consistent processing of all cadastral data for the whole country, or even for a single province, impossible
- Lack of homogeneity and compatibility of computerized systems
- Lack of tools, protocols, and procedures for systematic and periodic data exchange between the local and central administration
- Utilization of local coordinates in some cases, making integration with the other licenses in a GIS impossible

- Insecure cadastral information, with a high risk for unauthorized alteration of licenses or violations of the application priority system; this was the case for both paper files (due to the lack of signed registry books) and digital files

The direct consequence of these reforms translated (in practical terms) into a high risk for the security of tenure, because overlaps between applications and previously granted licenses could not be avoided. Potential investors perceived that the principle of first come-first served may have been violated. As mining investors lost confidence, the number of applications plummeted.

Figure 10. New Mining Applications in Indonesia, 1998–2002

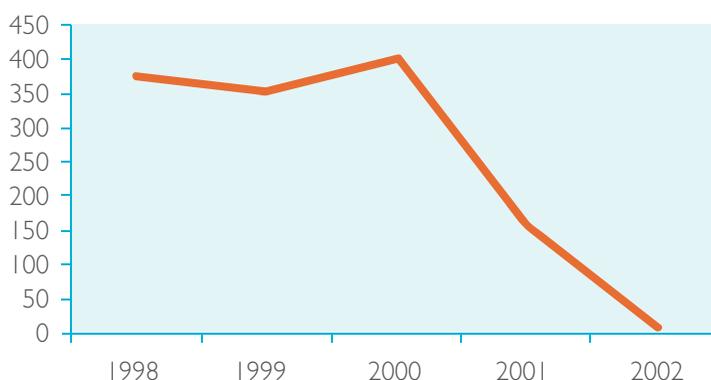


Figure 10 shows the evolution of the number of new applications per year in Indonesia between 1998 and 2002. During the first year of decentralization (2001), the number of new applications was less than half that of the previous year. One year later, new applications were practically nonexistent. Experience over the last decade has demonstrated that cadastral decentralization is suitable and operational only if a number of requirements are taken into account and if central coordination is maintained (as decentralization does not automatically imply autonomy). Unfortunately, this particular case is an illustration of the potentially undesirable impacts that may result if these preconditions are not met.

C. Alternative Approaches for Granting Mineral Rights

I. Key concept—Differentiation between “property rights” and “activity authorizations”

In most countries, ownership of national mineral resources is controlled by the state at the national and regional levels, as defined in the constitution. Mineral rights definitions and management principles are stated in the mining law, and practical implementation details are set in regulations. At a lower legal level, MRC procedures describe every step of the sequence of cadastral activities as well as all possible options and information required to process mineral rights applications, granting, maintenance, and extinction. Thus, a comparative analysis of different countries’ legal regimes would also indicate differences between their respective cadastral systems. Often, general legal principles are quite similar from country to country, and it is the regulations or, principally, the cadastral procedures that reveal country-specific differences in interpretation.

Although conditions for the management of mineral properties are similar to those of real estate in an increasing number of countries, mineral rights are time bound and additional restrictions may apply; issues include the capacity to freely sell or mortgage rights, minimum work requirements, and mandatory relinquishments. Different models have been adopted by different countries, ranging from rigorous conditions to access and limitations on property management to more market-based conditions.

The countries that have been successful in reforming their mining sector over the past two decades (measured in terms of attracting investments) are those where the management of mineral rights has been liberalized and conditions normally applied to other types of real-estate properties have been implemented. This liberalization of restrictions may include: (i) ability for holders to use their licenses as collateral for bank loans or mortgages or to transfer their rights without previous authorization from the state, and (ii) the simplification of minimum conditions to maintain these rights. The practical consequences of these innovations have been very positive, for example, in facilitating funding options. But their practical implementation, in particular for national companies, requires the presence of a banking sector that is familiar with mining practices, and the development of a market for mineral properties. Such conditions are not yet available everywhere and mostly exist in countries where there is a long mining tradition, such as Canada, Chile, Peru, and South Africa.

From a conceptual point of view, this trend reflects the functional and institutional differentiation between the property rights and the activity developed within the licenses (such as exploration or exploitation).

By comparison, such separation is obvious for other types of properties. For instance, ownership of a piece of land does not imply the automatic right to build a new building without the specific authorization of the municipality, while at the same time, maintaining ownership of the land does not require any special actions or demonstration of capacities, other than the ability to pay any required tax or mortgage or rental fees. Such differentiation also implies an institutional division between the management of the property and the activity. For example, land ownership may be registered in the land cadastre, but authorization for buildings is normally granted by another authority.

2. Practical implications of differentiating between “property rights” and “activity authorization”

Except in some countries in Africa and most in Latin America, mining laws often combine property- and activity-related criteria for the granting or maintenance of mineral rights. In such cases, and from an institutional point of view, the clarity of mandate regarding the management of mineral rights is poorly defined, and typical MRC functions are mixed up with those of the mining inspectorate and/or the GS. International experience in the last two decades has shown that one of the best ways to develop a performing institutional framework and attract investment in the mining sector is to have a clear institutional separation between the administrative responsibilities for granting mineral licenses and the control of mining activity. This separation is, in some respects, independent of the selected organizational model if some basic conditions are met; most important, the MRC should be independent from the GS and the mining inspectorate (including the environmental monitoring entity) in order to avoid potential conflicts of interest, technical interferences, and unnecessary operational overlaps.

This institutional separation of mandates is critical to guarantee most of the principles required for effective mineral rights management: transparency, lack of discretion, re-

spect of the discoverer's rights, and lack of subjectivity. Perhaps the best example of this is the transformation from an exploration license into a mining license. In many countries' legal frameworks, the presentation of an adequate exploitation plan is a requirement prior to the granting of a mining license. It is indeed obvious that governments must evaluate a mining project from a technical, environmental, and social perspective before authorizing its implementation and the starting of operations. But from the security tenure point of view, the question arises as to when this evaluation should take place: before or after the granting of the mining property rights. The application of the concept of differentiation between management of "property" and "activity" can solve this question, for both the state and titleholders, on the basis of the following cadastral rules:

- Titleholders that fulfill all their obligations during the validity period of an exploration license shall have the automatic right to transform it into a mining license. The granting procedure of this new license should be the sole responsibility of the MRC.
- When applying for the new mining license, titleholders must present (among other documents) their mining plans as well as their environmental and social impact assessment (ESIA) and environmental and social management plan (ESMP). But these plans will not be evaluated as part of the granting procedure. Rather, they will be transferred to the mining inspectorate and other entities responsible for the authorization—and, later, control—of the mining activity. The development and initiation of operations should be conditional on a proper ESIA and ESMP (including a closure plan), but the rejection of such plans should not imply the loss of the mineral rights.
- When plans are not approved, the holder will always have the right to revise them, or, if he estimates the mining would not be profitable under more stringent conditions, to recover their exploration investment by transferring the mineral property to another holder.

The same operational principles can be applied (with the required adjustments) to other cadastral procedures, such as renewal, transfer, mortgage, or cancellation of rights. They are consistent with the cadastre's mission: to simultaneously protect and guarantee the rights of both the state and titleholders. Experience shows that their practical application has been key to the successful development of the mining sector in many countries in Latin America (such as Argentina, Chile, Mexico, Peru), Africa (Madagascar or the recent reforms in Mauritania) and Asia (Mongolia in the late 1990s).

3. First-come, first-served versus auctioning

It is important to note the difference in the approach used by host governments to allocate rights for petroleum and mineral exploration. As a rule, most of the petroleum licenses are allocated using the "auctioning" or "competitive" methodology, while mining licenses are generally allocated on a first-come, first served basis.

One of the major reasons for the difference between the two industries is due to the basic features of mineral and petroleum geology, which translates to the different methodologies used by mining and petroleum companies to evaluate the economic potential of acquiring exploration rights. The geology of petroleum basins and data generated by early stage exploration is used to generate relatively robust inferences about the economic potential of exploration activities within basins over which exploration rights are being offered. Petroleum basin geology is such that there is a

tendency for discovery sizes to decline over time and the economic potential to be related strongly to size. Petroleum companies, therefore, tend to want to acquire exploration rights early and governments, as a result, are normally in a fairly strong position to use their control of exploration data to manage allocation of exploration rights on a competitive basis.

In contrast, individual mineral deposits tend not to be clustered to the same extent as petroleum deposits and, for the most part, exhibit quite distinct geological characteristics. The relationship between size of a deposit, time, and economic potential is less strong and inferences about the economic potential of exploration activities within an area over which exploration rights are being offered are much less reliable than those made in petroleum exploration. As a result, governments are in a weaker position to engage in the competitive process of allocating exploration rights. A number of other points contribute to the general use of auctioning in the petroleum industry, while it is only rarely practiced in the mining sector. Some of these reasons include the greater economic attraction of petroleum exploration due to higher upside potential, the effect on the supply of petroleum exploration acreage of restricted access in many parts of the world, and features of petroleum regulation that are conducive to competitive allocation by comparison with mining regulation.⁹

The “first come-first served” principle is the most frequently adopted criterion for granting mineral licenses around the world, applied in all countries where the mining sector is well-developed. Some mining countries use the “tender bids” methodology, as the auction system is called in the mining sector. If geological knowledge about a certain deposit is strong, whether due to the Government’s own exploration campaign, or through other activities, there is a strong case to choose the auction method.

The first-come, first-served method, which has been prevalent in the granting of mineral rights for centuries, has its pros and cons.

On the positive side, the removal of any discretion or subjectivity makes cadastral procedures transparent and impartial. Furthermore, the rule is easily applicable and controllable, using only the priority registry book. For these reasons, this principle is widely accepted worldwide by both titleholders and applicants.

On the other hand, some governments feel that the application of this method can lead to the granting of licenses to “inadequate” holders—for instance, those that may not have the technical or economic capacity to properly develop the mineral resources. In these cases, governments may prefer directed procedures that permit the selection of the “best” holder. But, depending on the rigor and transparency of such a directed selection process, there may be significant risks for titleholders and applicants, affecting their security of tenure.

In some countries, lively debates have begun between supporters and detractors of the first-come, first-served method. Some countries have chosen to auction grants because this can:

- Guarantee transparency in the granting of licenses, if some minimal conditions are respected

⁹ Based on Bryan Christopher Land, “The Similarities and Differences between Mining and Petroleum Investment: A Comparison of Industry Characteristics, Company Decisions and Host Government Regulation,” LLM thesis submitted to the Centre for Petroleum and Minerals Law and Policy, University of Dundee, June 1994.

- Allow the elimination of speculators from a transaction
- Ensure selection of a titleholder with sufficient experience and operational capacity for the exploration or exploitation of the area or deposit

Despite these potential advantages, however, the tender bid methodology may imply important risks for discrimination and subjective evaluations (and consequently also for corruption) if some minimal required conditions are not fulfilled. To address these problems, the legal framework should determine the general guidelines for the evaluation criteria, and the announcement for each individual bidding process should give all required information for tender far enough in advance for interested parties to prepare their offers—as well as details about deadlines and documents to be presented, precise information on the particular scoring and evaluation criteria to be applied, and a minimum score that will be considered acceptable. Tender conditions, scoring, and evaluation criteria should be consistent and proportional to the information available on the potential of the area.

In general, tender bidding is to be considered in cases where the first-come, first-served method is not applicable, for instance:

- When applications overlap immediately after the revocation, relinquishment, expiration, or annulment of licenses. In this case, as the cadastral information is open to the public, many interested applicants may have the same information and apply for the same area in a short period of time. In this case, countries may auction the same opportunities to all of the overlapping applicants. For example, the mining laws in Mozambique and Peru allow for the opening of a tender bid among overlapping applications in an area that has been revoked, relinquished, expired, or annulled, provided those applications are presented during the first hour in the day after the change in status.
- When the state, through geological research by its own institutions (for instance, when developing the geological infrastructure or geological maps), discovers some new deposit or some new potentially interesting area. In this case, as the new area has been found using public funds, the information should also be considered public, and there are likely to be several potentially interested applicants.

Based on the apparent transparency and effectiveness of the auctioning process—as well as its success in the granting of oil concessions—some countries have decided to adopt it as a standard method for mining. But, as described, oil sector conditions are very different from those in mining. As a result, the use of tender bids as an exclusive methodology for granting mineral rights has not generated the positive impacts expected; in fact, in some cases, it has posed an obstacle to effective mining sector development. Because the governments using the tender bid methodology could only offer areas that have known geological potential, this process slowed down exploration, and some potentially interesting areas were completely ignored.

In cases where tender bidding is deemed appropriate for the mining sector, other practical lessons from international experience can help to improve the implementation of tender bid procedures, for instance:

- An exploration license that has been reverted to the state, whether as a result of voluntary release or of cancellation, does not need to be automatically subjected to tender bidding, except in the case of availability of pertinent data or of overlapping applications. In the latter case, the area should be declared vacant and available for granting on a first-come, first-served basis. Some countries



require that all released areas be auctioned. This practice generates serious backlog problems, such as in Mongolia, where many abandoned areas, most with no particular mining interest, are subjected to the bidding process, implying an enormous amount of work for the administration. In these cases, a filter process is strongly recommended.

- Although bidding is not a default procedure for exploration licenses, it is a granting procedure under the official licensing activities and responsibilities. Bidding should, therefore, be organized and managed by the MRC rather than the mining directorate or the GS. The MRC can cooperate with these organizations to assemble relevant data.
- In cases when the deadline for offers expires with no bids received, the areas must be declared vacant and ready to receive new license applications that will be granted on a first-come, first-served basis. This avoids the problems experienced in Mongolia.
- In order to not block private exploration over an excessive period of time, it is recommended that limitations be introduced for the duration (validity) and the number of areas that are “reserved” for state activity and will be offered afterward by tender bid. These limitations should be clearly detailed in the legal framework; for example, in Mauritania, a maximum of two reserved areas can exist simultaneously, each having a maximum validity of three years.

D. Measures for Controlling Speculative Practices

In a financial context, the term *speculation* (derived from the Latin *speculatio*, which means “contemplation” or “observation”) is normally understood as the assumption of risk in return for the uncertain possibility of reward. Speculation occurs in virtually all economic activities, causing prices to exceed their real value because of potential demand.

In the mining sector, the term *speculation* is most often used with negative connotations: to refer to titleholders who apply for licenses with the intention of selling them later and, in the meantime, hoard the licenses without development of significant activity on site. In countries where this practice is very common, it may impede development of the mining sector; and cadastral management may be needed to decrease the negative effects of speculation, mainly by setting conditions for the validity of mineral licenses. Before taking steps to limit speculation, however, it is important to understand the practice and consider its negative and positive effects:

- As noted above, speculation is present in all economic activities and can be considered part of the framework of economic activity itself. As such, the objective of cadastral management should not be to completely remove speculative practices—which is objectively impossible—but to discourage them and thus keep them at acceptable levels.
- In addition, not all speculative practices should be considered totally negative. In some cases, at least in the mining sector, speculation may be either “passive,” where no activity is developed inside the mineral licenses that are completely dormant, or “active,” where reconnaissance or exploration activities are developed in order to promote the property and increase its selling value. This type of active speculation (typically done by junior companies) plays an essential role in the development of the mining sector, at least during periods where prices are low or in risky areas, because these types of companies are normally able to take

higher risks. Consequently, any measures taken to decrease speculative practices should be focused on passive rather than active speculation.

- Any measures introduced to decrease speculative practices should respect the essential principles previously discussed, particularly the security of tenure and lack of subjectivity. Otherwise, such measures may affect the transparency of management or a region's attractiveness to investors—with an impact potentially worse than that of speculation.

An additional problem with speculation is the level of cadastral saturation. In many countries, it is still considered a problem that a substantial part of the national territory is occupied by mineral (exploration or mining) licenses. In other cases, in countries where the mining sector is well developed, a high occupancy level is considered an indicator of good cadastral management and good performance in general—the mining sector is able to attract investment. To understand the real sense of this occupancy rate, it is necessary to consider that the largest part of the surface corresponds to exploration licenses, and these permits represent the research effort to find new mineral resources, where the main beneficiary of this effort is the country. Without attracting investments for mineral exploration (because it is normally not the role of the state to invest public resources in high-risk mining exploration ventures), it is not possible to adequately develop the mining sector.

In countries such as Chile and Peru, where the entire mineralized area is covered by licenses, if an area becomes free it is immediately occupied by a new application. This dynamism, where active speculation plays an important role, is not considered negative but rather an indicator of the vitality of the mining sector. In this respect, cadastral policy should encourage license transfers (the mineral licenses market) in order to facilitate an increase in the added value of mineral permits and, consequently, the transformation of passive speculation into active speculation. In other words, in countries where the mining sector is developed and there is a real market for mineral rights, speculative activities are not generating negative effects. On the other hand, in countries where this market does not exist, problems from speculation may increase if this transformation is obstructed by the legal framework and cadastral procedures. In that case, the state administration may be responsible for the increase in passive speculative practices.

The following subsections look at a variety of corrective measures that have been implemented to decrease speculation.

I. Escalating fees

Two methods frequently used to decrease passive speculation practices are escalating rental fees and mandatory relinquishment requirements.

Escalating rental fees require the holder of a license to make regular yearly payments of a fee per unit of area (square kilometer or hectare) in order to retain the concession. These fees discourage unproductive holdings and also help pay for administration and provide revenue for management of the mining sector.

Initially, countries established rental fees as fixed amounts (the same every year), but the inefficiency of this method soon became apparent, as it did not encourage voluntary relinquishment of unwanted parts of the license areas. The method was improved by introducing the escalating fee, which was promptly adopted by many countries, including Bolivia, Madagascar, Mauritania, and Peru. This system has been adopted in

two different modalities, with values increasing year by year, or values increasing every two or three years. Practical experience has shown that for values to escalate yearly is much more efficient.

Ideally, the level of fees must be high enough to avoid speculation, but, at the same time, low enough to attract investors and to allow for the participation of national and small-scale miners. This balance should be adapted to the particularities of each country: low fees can be seen as adequate to attract investment in little-explored mining countries, such as Madagascar or Mauritania, which cannot establish levels as high as those in very well-known and attractive countries such as Chile or Peru.

At the same time, the design of an escalating fee system must be well adapted to the most frequent strategy for exploration; in other words, low-cost during the first validity period when companies are obliged to apply for large areas, and, progressively, more expensive during the subsequent validity period when companies normally reduce the area of interest to focus on detected targets (and when, in other cases, the real passive speculation starts). Thus, the adequate implementation of these principles requires fine-tuning the level of the fees to the situation and characteristics of each country, as well as to the market prices.

While it is true that escalating rental fees have, in many cases, been unable to stop speculation, this failing has resulted more from inadequate fees than an inefficient methodology. This has been especially evident during the past few years, when the dramatic rise in metal prices and the increase in demand for exploration licenses around the world saturated many cadastres and drove fees too low. As a result, passive speculation increased dramatically in countries such as Mauritania and Mongolia, which are currently modifying their escalating surface fees (see Table 2).

Table 2. New and Old Surface Rental Fees in Mauritania and Mongolia

YEAR	\$ / Ha (OLD FEES)		\$ / Ha (NEW PROPOSED FEES)	
	Mauritania	Mongolia	Mauritania	Mongolia
1	0.48	0.1	0.082	0.5
2	0.48	0.2	0.163	1.0
3	0.48	0.3	0.245	2.0
4	0.55	1.0	0.408	3.0
5	0.55	1.0	0.612	4.0
6	0.55	1.0	0.816	5.0
7	0.087	1.5	1.224	10.0
8	0.087	1.5	1.633	15.0
9	0.087	1.5	2.041	20.0

Based on these experiences, it is clear that rental fees should be managed in a dynamic and flexible way, ready to be adapted to any changes in the parameters controlling the mining sector. For this reason, it is recommended that these values be established in regulations or in a specific decree (where they can be modified) and not in the text of the law, where amendment is always more difficult.

It is important to note that this discussion of escalating rental fees has been addressed toward exploration licenses. Mining licenses should also be subject to rental fees, but

the problems related to speculation and investment level are completely different. The level of fees for mining licenses should be higher than exploration because, in comparison to the exploitation costs, these rentals constitute a relatively insignificant burden, and furthermore, the surfaces of the mining licenses are always much smaller than exploration ones. In general, the main advantages of the escalating surface rental fees methodology include that:

- Its implementation is easy, direct, and guarantees transparency without discretion (since no interpretation or subjective evaluations are required) and thus minimizes potential corruption.
- It generates revenues that may guarantee economic sustainability for the administration of the entire mining sector.
- It can be easily adapted to the evolution of the metals market and the mining sector in general, as well as to the local conditions and characteristics of each country.
- It guarantees security of tenure because it stimulates voluntary relinquishment by offering incentives for reducing the surface area of a license, without the introduction of risks for the titleholder.

Despite the advantages cited above, the escalating surface rental fee system is not perfect and may have potential negative impacts if it is not properly managed. Although there may be no potential for direct corruption linked to its application, there may be corruption in the use of the generated income if the required institutional controls are not in place. Similarly, the original sense of this rule (a fee as compensation for service) can be distorted and misunderstood as a procedure to make money. Both risks exist and must be carefully restricted by institutional controls.

2. Mandatory relinquishment requirements

An alternative to the escalating surface rental fees methodology for decreasing speculative practices is a mandatory relinquishment requirement that involves periodic obligation to reduce the surface area of the exploration licenses. This reduction is normally required when the license must be renewed and the percentage of required surface reduction varies from one country to another, sometimes reaching as high as 50 percent (as it does in the DRC or Zambia, for instance).

As in the case of escalating rental fees, the application of this methodology is easily implemented; it is transparent, objective, and involves no discretion. This methodology can also be very efficient because it guarantees that no large surfaces (after successive and mandatory relinquishments) will be controlled by a single titleholder. In practical terms, however, this is not always the case because it would imply additional provisions such as a prohibition against reapplying for areas relinquished and not always clearly stipulated in the legal framework or otherwise very difficult to verify (for example, if a lease is reapplied for by intermediaries).

Another disadvantage of the mandatory relinquishment method is the lack of flexibility; it is impossible to adapt it to the evolution of the metals market or the mining sector, in general. In addition, it also risks decreasing the security of tenure, particularly in the case of successful prospecting projects, because the holder may have difficulties maintaining the property over the discovered resources and discouraging other prospecting investments. Some countries, such as the DRC, have already seen these practical difficulties in the application of the mandatory relinquishment requirement.

The evolution of the mining sector and the metal market impacted the opinion re-



garding the mandatory relinquishment requirement in the minds of many in the mining sector. In 2008 many companies were concerned about lack of free space for new exploration projects. Rising metal prices increased the number of applications and saturated many cadastres around the world thus decreasing the number of vacant areas. Furthermore, a significant portion of these granted areas were held by speculators who sometimes blocked the entry of investors who might be able to actively explore, discovering new resources and contributing to the development of the mining sector and generation of revenues. This situation represents a real problem, and large companies (who now perceive junior companies as speculators) would like to see the implementation of very aggressive cadastral procedures aimed at decreasing the rate of occupied areas, such as mandatory relinquishment or even the shortening of validity periods for licenses.

Nevertheless, when commodity prices are low, the same major companies are satisfied to play the roles of junior companies as explorers who undertook risks that are unacceptable for larger companies. At the same time, when the feasibility of the deposits is poor due to low prices, these companies are also happy to hold licenses for a long time (in order to save the realized investments in exploration), waiting for prices to rise or technology to improve the recovery rates.

Circumstantial factors should not affect the essential systems that are implemented to guarantee the security of tenure of mineral rights and the attractiveness of the system for investments. It is recommended, therefore, that before the adoption of any measure designed to correct the speculation level, its positive and negative effects should be carefully evaluated. Quite often, some measure with immediate and apparent benefits in the very short term may have unwanted consequences in the middle or long term. These negative consequences usually result in a decrease in the security of tenure and a consequent decrease in the attractiveness of the country for investors.

3. Minimum investment requirements and minimum work obligations

Another option to encourage exploration and decrease passive speculation is the use of annual minimum investment requirements or minimum work obligations. Conceptually, this is an excellent idea because it guarantees that the titleholder is really developing exploration activities and the license is not dormant. But experience shows that there are practical difficulties that may arise in the implementation of this option.

One challenge is how to set the value of the minimum requirement for work or investment that must take place to ensure that an adequate exploration level is carried out. The requirement must be substantial enough to efficiently discourage speculation and in line with the standard exploration costs of any type of deposits in any geological environment. Taking into consideration the variety of metallogenic contexts, there is no simple technical solution for this question. The more practical option would be to adopt a single calculation linked to the applied surface and to the rental fee (for instance, 100 times the rental fee per surface unit). The requirement can then be easily adapted to the evolution of the metals market and mining sector in general, as well as to country-specific characteristics (as in the case of the surface rental fees) by just updating the values of the required amounts.

As shown by experience, however, the main difficulty lies in the practical verification of the amount of resources, in terms of investment, time, or effort spent by the titleholder. One condition for proper control relates to the availability of staff and resources, considering that, among other factors, such activity does not generate rev-

enues to cover those costs. Also, from a cost/benefit perspective, it would require the services of qualified staff, a scarce resource in countries with limited mining traditions, as well as a well-functioning mining inspectorate with a dedicated budget and logistics infrastructure to assess the value of the implemented exploration program or even whether such program has indeed been actually carried out at all within the considered area. Another problem related to lack of resources is the difficulty of assessing, on the ground, the value of reports submitted to demonstrate the works developed and the investments realized. In addition, there are also cases when such evaluations imply a certain degree of subjectivity, with the consequent potential for bureaucratic bottlenecks or risks of discretion or corruption.

4. Other types of measures to restrict speculation

In addition to the main methodologies discussed above, countries have adopted other measures to discourage speculative practices and stop the hoarding of large surface areas with speculative purposes. One approach has been to introduce limitations on the maximum size (surface area) per license in the legislation. This measure is logical for rationalizing cadastral management by avoiding excessively large and unmanageable licenses, but is not effective against speculation because it is not linked to the renewal fees or the activity to be developed. Furthermore, in many countries there is no limitation on the number of licenses to be held by a single titleholder; and, consequently, no limitation on the maximum surface area to be held by a single titleholder.

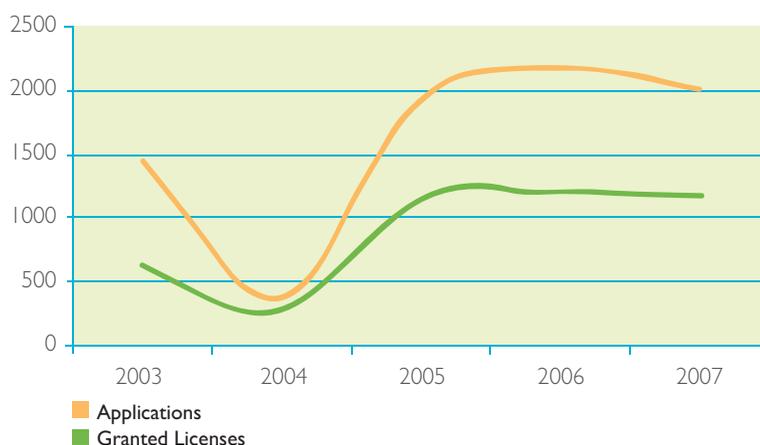
Some countries have introduced such a restriction, preventing a single holder from having more than a limited number of licenses, determined by law. Nevertheless, this rule could be equally inefficient because, in practical terms, holders may control many licenses through intermediate holders, exceeding the authorized number; generally, the MRC's administration does not have the capacity to detect these irregularities.

Another option, also applied in many countries, is to “filter” the entry of potential speculators by requiring a minimum level of economic and financial capacity as a precondition for granting a license. It is assumed that many speculators do not have the economic resources to properly develop exploration activities and, with an obligation to prove the availability of certain economic resources, this rule would (statistically) prevent the entry of passive speculators. Technically, the application of this rule is very similar to that of the minimum investment requirements or minimum work obligations explained above, and the required capacity may be established by a simple calculation linked to the applied surface and the rental fee (for instance, ten times the rental fee per surface unit). As in the previous case, the implementation of this rule appears direct, objective, and can be easily adapted to the evolution of the metals market.

The availability of the required amount may be demonstrated by a bank certificate showing the applicant's own or borrowed funds. Normally, only certificates from the national bank system are accepted (considering that investments must be realized inside the countries), although legislation is often unclear on this respect. But the main limitation of this method is that certificates prove the availability of resources just for that particular date, and such resources may be mobilized and transferred for other purposes a few days later. Practical experience demonstrates that many of the titleholders who exhibit the availability of the required capacity do not use the funds for developing exploration activities after being granted a license.

The experience of the DRC is a good illustration of a country where this system has been developed. Figure 11 shows the evolution of applications for exploration and mining licenses (orange line) in comparison with the number of granted licenses (green line). Logically, the number of granted licenses is always lower, but the difference is what is significant here. Approximately 40 percent of applications are rejected, and most of these rejections are due to lack of demonstrated economic and financial capacity by the applicant. Nevertheless, many of the granted licenses are still dormant.

Figure 11. Evolution in the Number of Mineral Rights Applications and Granted Licenses in the Democratic Republic of Congo, 2003–2007



Based on the analysis in this section, a system of escalating rental fees, properly applied and adapted to local circumstances, is recommended as the more flexible and easily adapted measure to decrease passive speculation. The system also has the additional advantage of generating significant revenues for the sustainability of the mining sector administration and not introducing subsequent risks for security of tenure.

E. Small-scale and Artisanal Mining and Cadastre Management

Although still illegal in many countries, artisanal mining represents an important opportunity to generate resources and contribute to poverty reduction in areas and communities without many other income alternatives. For this to happen, however, it is critical to facilitate the legalization and formalization of the artisanal miners, integrating them into the overall mining rights management system instead of enclosing them in a mining “ghetto.” The principles of security of tenure and transferability are fundamental to facilitating a transformation of informal and illegal mining into a better and less damaging activity for the artisans. Also, it could be considered good practice from an administrative perspective to unify the management of the whole mineral rights licensing system (including quarries and small-scale activity) in a single and general regime that is under the responsibility of a single cadastral agency.

Nevertheless, there are many examples of countries, such as Mauritania or Mongolia, that have developed separate licensing procedures for artisanal and small-scale mining, gemstone mining, and mining of construction materials (for example, quarries). With

this differentiation, such types of licenses are managed outside the mining legislation and, consequently, outside of the MRC management.

Practical experience has shown, however, that keeping these special types of mining activity outside the general mining regime leads to serious rights management and operations monitoring difficulties. First, and strictly from the cadastral point of view, to separate management across standard licenses and quarries or artisan permits always produces overlap because of lack of coordination between the two administrations in their procedures for granting licenses. These overlaps then cause conflicts and potential risks for titleholders. Second, when these special types of licenses are outside the general mining regime, it is impossible for the state administration to adequately manage the activities for issues related to environment, safety, health, and control of production.

Generally, in countries where the artisanal mining regime is outside the general cadastral regime, such a system has been adopted in an effort to find direct solutions for the small-scale mining sector itself, without evaluating the impacts on the whole cadastral regime, especially as they relate to security of tenure. Some countries permit overlapping activities by artisanal and small-scale miners within standard licenses, conditioned on the previous written authorization of titleholders. Although this measure is, in most cases, welcomed by titleholders in order to avoid problems with local communities during operations, it is only an operational solution if:

- The cadastral rules clearly establish procedures to be followed and the deadlines to be respected before granting an overlapped license
- The geometric rules to delimitate the artisanal mining rights are consistent and homogeneous with the general regime; in this respect, it is very important to respect the size and features of the CU, which must remain indivisible and represent the minimum cadastral perimeter

One practical corollary of the previous points is that small-scale activity in the country should be taken into consideration before the selection of the CU size and geometry in each country. Consequently, this decision must be based not only on the cartographic and geodesic constraints, but also on the scale and characteristics of small-scale mining activity.

Another potential solution is to restrict artisanal activities to some selected areas, delimited and created by the mining administration. This solution could be valid if the procedures for the creation of such reserved or restricted areas follow the cadastre rules, in particular:

- The restricted zones should be created in vacant areas and cannot overlap with existing licenses or pending applications
- The geometry of the restricted zone perimeter must fulfill all the geometric restrictions imposed on the standard licenses
- The restricted zone should be cancelled (and the area declared vacant for new applications) when no small-scale activity is being developed within the perimeter

The main advantage of these restricted zones is that limitations imposed by CU characteristics may be “violated” inside the perimeter because the general cadastral consistency is guaranteed by the external perimeter. On the other hand, the main inconvenience is related to the reluctance of small-scale miners to be limited to such official perimeters. Some countries, such as Ghana or Zambia, have adopted this restricted area model although in Zambia it is limited to the exploitation of gems (emeralds).

F. The Influence of Tradition and Sector Experience on Cadastral Activity

The 1996 World Bank publication “Latin America Mining Strategy Study”¹⁰ concluded that the key variables controlling the development and sustainability of mining sector institutions are human resources, management quality, financial resources, and the existence of a mining tradition. With very small adjustments, the conclusions obtained in that study are still valid today; this subsection will discuss these factors as they relate to cadastral matters around the world.

It is important to add another variable, political interference, which may affect all of these parameters, with particular impact on recruitment and management. Establishment of a clear institutional framework, respect for civil service rules, and legal constraints against discriminatory power are the most efficient tools to limit such interferences.

I. Human resources

Adequate staffing is the backbone of any institution, especially in the case of an institution as sensitive as the MRC, and the availability of educated and trained professionals with experience in cadastral issues (or the ability to develop their knowledge on these matters) is critical. Mining sector service enterprises and universities may provide a source of potentially valid professionals, but this is not enough in countries where the mining sector is not yet developed and there is no experience in the management of an MRC. In these countries, sector service enterprises and universities will not be able to provide the required staff without complementary and specific training. Consequently, mandatory training activities should be organized and implemented (with the participation of experienced foreign experts if national expertise is not available), along with training trips to other countries that have institutional experience in cadastral management and where the mining scale factor, level of economic development, and MRC issues are similar.

In all cases, skills and staffing needs should be identified and the necessary professionals recruited; this recruitment should take into consideration the need for sufficient incentives such as adequate salaries. The main focus should be on the senior executive jobs, administrative posts, and cartographic and GIS technicians. In addition to personal honesty and integrity, all candidates should have a general understanding of the mining sector and be familiar with its legal and regulatory framework and applicable computing tools. The institutional organization of this recruitment process should include control mechanisms to ensure the transparency and reliability of the system.

Staff improvement and training should be accompanied by a parallel optimization (in most cases a rationalization) of personnel and the implementation of pay scales that are relatively competitive with private industry. Since pay normally depends on civil service rules that apply to the whole government, civil service reform is critical to the adequate staffing of PMIs in general and the MRC in particular. The development of a reward system based on rational criteria together with challenging and meaningful long-term programs would certainly attract professionals with adequate qualifications. In some countries where the MRC is an agency external to the organization of the ministry, it has been possible to avoid the restrictive civil service system for payment and recruiting by adoption of organizational statutes similar to those of

¹⁰ “Latin America Mining Strategy Study” published by the World Bank, 1996

public enterprises. In these cases, the MRC is considered a “public company,” ruled by an administrative board with oversight autonomy in all areas, including staff recruitment and determination of salary rates. This solution has provided excellent results in some countries, such as Madagascar, although its implementation depends upon its compatibility with the general civil legislation framework. In addition, it also needs self-controlling mechanisms and surveillance to avoid corruption and abusive practices, particularly in less developed countries.

2. Management quality

Institutions generate credibility and attract support when they are thought to be well managed, and the MRC is no exception. Good management is essential for the correct interpretation of legal procedures, effective application of cadastral procedures, and the security of tenure of mineral rights.

Good management also means, in practical terms, respecting procedures, ensuring the optimal use of resources, and coordinating with other entities to avoid duplication of work. The existence of a strong civil service tradition, which ensures adequate selection of personnel and budgetary priority, is a key factor in achieving adequate management quality on a sustainable basis. But the presence of such a general tradition, if it does not exist in the mining sector, does not guarantee the availability of the required staff and complementary training activities.

3. Economic sustainability and financial management

While the previous sections have analyzed some important functional criteria to be considered in designing an adequate organizational model for an MRC, it is equally important to consider economic criteria when designing a cadastre. Institutions need to be financially sustainable to succeed. In the case of the MRC, this sustainability is essential to guarantee effective management of the entire mining sector.

In principle, an institution such as an MRC—responsible for collecting annual rental fees linked to mineral licenses—should not have trouble generating enough income to be economically sustainable. In fact, in most mining countries, the revenues generated by the MRC with just a standard level of mining activity (sometimes combined with a percentage of the royalties) would be sufficient to guarantee the required economic resources for management of the entire mining sector, including the cadastral activity itself as well as the GS, the mining inspectorate, and the environmental monitoring agency. The concept of redistribution of income generated by the mining sector among all the agencies responsible for its management is even prescribed in the legislation of many countries. Practical experience, however, has demonstrated that, in some cases (and sometimes against the legal provisions), the generated economic resources are not received by these agencies, thus creating obstacles to effective mining sector management.

While there is no substantial difference, from the viewpoint of organizational efficiency, between locating the MRC as a department inside the ministry or as an agency external to the ministry, this decision may seriously affect the economic sustainability of the institutions. Normally (although these rules may vary from one country to other), budgets for the departments or administrative units located inside the ministry organization are exclusively dependent on the general state budget and controlled by the Ministry of Finance.



In contrast, an agency external to the organization of the ministry, created as an autonomous institution empowered with the capacity to manage its own income (although with the necessary restrictions on how to use and distribute such resources), can provide solutions for the sustainability of management of the whole mining sector. Some countries, including Algeria and Madagascar, have successfully adopted this model, establishing MRC agencies as “public companies” linked to the ministry in charge of mining. As companies, these agencies are managed by a board that controls the activities developed by the executive director.

While details about the collection and redistribution of fees may be fixed in the legal framework and the agency statutes of a country, international experience has shown that the Ministry of Finance is, at times, reluctant to lose control of the income generated by taxes and fees derived from mining activity. The ministry may claim exclusive right for such distribution, even against the recommendation of the mining law, making it difficult to reach an agreement on the distribution of royalties, because they are real taxes linked to mining activities and consequently under the jurisdiction of the ministry. On the contrary, the opposite applies to surface rental fees, which technically represent payment for services provided by the state to administer the mineral rights, and therefore are not considered taxes. This differentiation, if properly highlighted in the mining legal texts, facilitates the administrative procedures for the MRC to access stable and sufficient sources of income and to guarantee its economic sustainability. This model has been successfully applied in Madagascar and the DRC and is presently being implemented in Mauritania.

As with any solution, the adoption of this system (strongly dependent on civil legislation) will vary from country to country because the organizational models cannot be simply exported without adaptation to local characteristics. But the important point here is, although there is no difference between internal and external MRC agencies solely from the organizational efficiency point of view, the selection of the external option (if compatible with the existing legal framework) may have substantial advantages for the institutional sustainability not only of the MRC but the whole mining sector.

Reliable, consistent, and stable resources to finance personnel, infrastructure, and operations are indispensable to the fulfillment of the responsibilities of the MRC. This issue is particularly acute in lower-income countries and countries in economic crisis, which tend to allocate just enough to cover salaries and a few current expenses. In these cases, the standard fiscal resources (for example, the funds provided through the normal government budget) should ideally be sufficient to cover all expenditure requirements. But practical experience demonstrates that often, due to various reasons, the PMIs in general and the MRC in particular do not get adequate resources.

Other sources of income, such as revenues generated by fees from the supply of services (in the case of the MRC, the demarcation of mineral rights on the ground), are considered in some countries as a natural complement to the government budget. But these activities often do not generate significant resources and may potentially generate conflicts of interest. For reasons mentioned, it would be preferable to restrict these types of services to cases where disputes about the location of license boundaries exist (when the MRC must act as an institutional referee) and to transfer the provision of these services, under the general supervision and monitoring of the MRC, to the private sector.

On the other hand, the direct allocation of part of surface rental fees and mineral rights fees to the MRC and other PMIs can be a stable source of revenue for those institutions,

as has been seen in Madagascar and Peru. Furthermore, this solution is usually applied worldwide in land management agencies. Sustainability is essential to guarantee the correct management of minerals rights, and an institution such as the MRC, which is responsible for collecting payments of annual rental fees linked to mineral licenses, should not have any problem getting enough funding to be economically sustainable.

Finally, it is important to mention that international support from multi or bilateral entities has been, and still is, an important source of funding for sector institutions in general and the implementation of new MRC organizations in particular. In this respect, careful planning for the allocation and control of these funds during and after the end of the aid program is essential to avoid dependency on external funds and to guarantee sustainability. Unfortunately, there are many examples worldwide where the “beneficiary” institutions collapsed immediately after the end of aid programs.

4. The role of tradition and development in the applicability of cadastral rules

In addition to previous parameters (human and financial resources and management quality), the ability of the national institutions to promote and regulate the mining sector is influenced by the presence or absence of a national mining tradition. This is a measure of the historic and actual presence of mining activities, and the existence of established mining institutions and operating companies. The contribution of mining to the national economy influences employment patterns and the specialties chosen by students and workers. As a result, there are normally no difficulties in finding experienced technicians and engineers who understand the particularities of the mining sector in a country with a mining tradition. But the more important impacts linked to the mining tradition are institutional, social, and political.

In countries where the mining sector is well developed and mining activities represent a substantial contribution to the national economy, institutions linked to mining activity (particularly the MRC, which ensures the security of tenure for mineral rights) are normally well established and operational. Furthermore, if institutional modifications or adjustments in the legal framework are required, these changes can be easily assimilated and implemented. In contrast, the implementation of a new institutional organization and the achievement of efficient operations in countries where there is no mining tradition are difficult, and the transition, in the best of cases, takes several years. During this transitional period, substantial changes in the mentality and efficiency of the mining administration must be introduced. Before this minimum level of efficiency is reached, it is practically impossible to correctly develop the control and monitoring operations required for minimum work requirements or minimum investment obligation rules, the main reason being the limited experience and capacity of staff who are frequently underpaid.

Similar difficulties can be seen at the social and political levels. In countries where the mining sector is still new, and where mining activities do not yet represent a substantial contribution to the national economy, some groups have difficulty understanding mining activity in general and the MRC in particular. This situation can generate misunderstandings and distortions, as, unfortunately, the mining activity and the entry of foreign investors are often regarded as a source of problems. In addition, the differences between exploration and exploitation activities is often not properly understood, and this situation may ambiguously be exploited at the political level when transmitting to the public that most of the national territory is sold for mining, without mention of the economic and social benefits derived from the mining sector and the fact that

(statistically) only one in every thousand prospects eventually becomes an economically viable exploitation project. In fact, the largest part of the surface corresponds to exploration licenses and these permits represent the research effort to discover mineral resources, where the main beneficiary of this effort is the country. International experience shows that the political and social misunderstandings noted above often introduce serious difficulties during the transitional period in countries that are trying to develop their mining sectors.

G. Looking Ahead

In 2008, with the downturn in the global economy, the mining industry saw a sharp drop in almost all commodity prices. While, in early 2008, mineral economists were studying the possible effects of a commodity price “supercycle,” in late 2008 and early 2009, they focused on managing a sharp dip in those prices. One of the roles of an MRC office is to assist in balancing out periods of high and low commodity prices so that the mining investment level is maintained. In particular, during the “down” cycle, the MRC should be charged with the following:

- Collection and maintenance of relevant geological data during the license transfer process
- Identification and preparation of documentation for auction (for areas that have available geological information, from released exploration projects, or abandoned exploitations, and so on)
- Support of the consolidation of current investments and projects
- Implementation of transparent procedures and realistic criteria for auctioning
- Promotion of resources to potential investors
- Maintenance of institutional autonomy
- Education in new technological developments
- Adaptation of escalating fees in accordance with exploration activity

Another important issue for an MRC is decentralization. In particular, integrating artisanal and small-scale mining into MRC system management will require clear rules and procedures and simple technology that is readily available and easy to implement in any country. In countries with much artisanal mining, separate rules and regulations are needed to minimize conflicts between this and large-scale mining. An MRC could potentially play an important role in the process of formalizing and legalizing artisanal mining.

V. Case Studies



Although the first requirement for the development of a mining sector is the presence and accessibility of mineral resources, this condition is not sufficient for success. Many countries around the world have an important geologic and metallogenic potential that is not being explored and exploited at a level proportional to their mineral potential because these countries are not attractive to investors. The effective implementation of an MRC is one key step toward reducing risks and increasing the security of tenure for titleholders, and thus the attractiveness of a country for investment.

This chapter discusses the practical lessons that can be learned from the experiences of mineral rights management in eight mining countries from around the world, some of which succeeded in effectively developing their mining sectors and others that faced difficulties in doing so. To facilitate the comparison of experiences across countries, we review the legal and institutional characteristics from a perspective of mining tradition and human resource availability, summarize some of the main achievements in terms of investments or other spin-off effects regarding land management, and identify areas for possible development.

Some of the examples give details on the number of applications for new licenses per year, which is considered to be an indicator of the level of attractiveness and dynamism of a country's mining sector. This number is independent of the country's mineral output, as high levels of production from long-established mines might hide a progressive decrease of interest for exploration or development investments in an "aging" country sector. Watching the cadastre activity would alert authorities of the need to modernize the sector competitiveness at regional and international levels.

A. Algeria

1. Background

Algeria recently implemented a new cadastre system as part of its overall legal and institutional sector reform. Algeria is mostly known as an oil and gas producer, and its mining sector has, so far, played a minor role in the country's economy not proportionate to its high mineral potential, as suggested by its geologic and metallogenic background. Both sectors are managed under the same Ministry of Energy and Mines, focusing mainly on hydrocarbons. The mining institutions are well structured and have the necessary resources to comply with their mandates. Because huge oil-generated resources have allowed the country to achieve high education levels, the availability of capable and experienced human resources is not a problem.

2. Approach

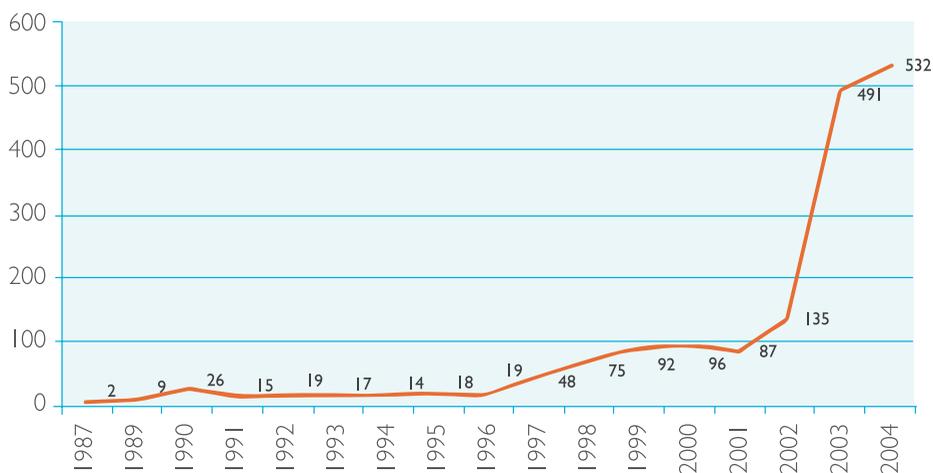
- *Legal framework.* A new Mining Law, promulgated in 2001, established the conceptual basis for managing mineral rights, taking into account best international practice, including the granting of licenses on an apparently well-balanced mix of first-come, first-served and auctioning bases. This law was complemented by the approval of specific licensing regulations in 2002, the institution of an autonomous cadastral agency in 2004, and, finally, the computerization of the cadastral management and procedures in 2005.

- *Institutional framework.* Presently, the Algerian cadastre (the ANPM¹¹) is located in modern and well-adapted facilities at the headquarters in the capital city. It has access to a complete computer infrastructure and is staffed with trained and efficient personnel. With adequate funding, mechanisms have been established for the sector agencies, and the cadastre is, in practical terms, suitably equipped to operate properly and be economically sustainable. From logistical, human, institutional, financial, and legal points of view, Algeria also has the components required to have a well-functioning MRC and to effectively manage mineral rights.

3. Achievements

The evolution of cadastral activity reflects these improvements in the country's legal and institutional frameworks for mining. As shown in Figure 12, the number of valid licenses per year for all types of permits increased sharply in 2003, immediately after the implementation of new cadastral rules.

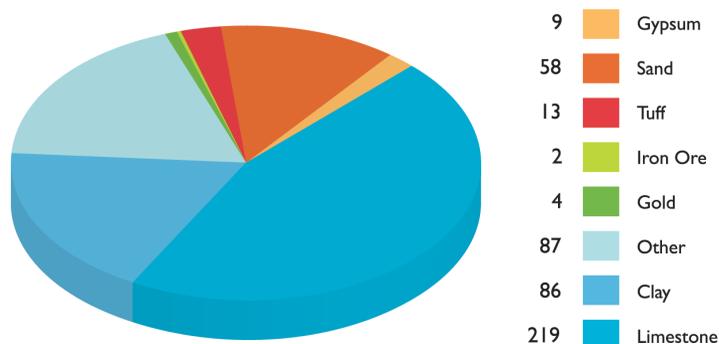
Figure 12. The Evolution of Cadastral Activity in Algeria



A large majority of new licenses resulted from the successful implementation of an auction program (in line with the mining code's provisions) and related to quarries, small-scale exploitations or exploration licenses for building materials, or already known prospects. Applications for new mining projects, searching for gold, diamonds, or base metals were practically nonexistent, as shown in Figure 13. In 2002 the 87 licenses labeled as "others" included mostly other building materials (granites, puzzolane, andesites, schist, and so on), while only 6 were focused on potentially larger-scale metallic ores (2 for iron) or precious metals (4 for gold). The important diamond potential was not properly explored.

¹⁰ ANPM stands for "Agence Nationale du Patrimoine Minier" or National Agency of Mining Domain.

Figure 13. The Breakdown of Exploration Licenses in Algeria, 2004



Another important point to consider is that 99 percent of titleholders in 2004 were nationals, with few foreign investments (mostly in a mature gold prospect and operating large iron mines). As a result, the level of cadastral activity and the corresponding foreign or national investments in exploration and green field new development is not proportional to the size and high mineral potential of the country. One of the main reasons for this situation was the decision of the Algerian authorities to prioritize the granting of titles through the auctioning process. This may have been due to the country's prior oil sector experience, which favored auctions rather than the first-come, first-served approach.

B. Argentina

I. Background

Historically, Argentina's mining sector has suffered from lack of development. The reasons for this lack included an inadequate institutional organization, an obsolete legal framework—the 1875 mining code was not amended until the 1990s—and the need to transform the role of the state from both regulator and operator to just regulator. The political organization of the country also created obstacles to the modernization of the mining sector on a national scale: Argentina is a federal republic, composed of 23 provinces, each of which has its own constitution, ownership of its mineral resources, mining regulations, mineral rights granting procedures, and taxation system. Under such conditions, mining investments were highly risky because of the political and regulatory heterogeneity and uncertainty (for example, provincial governments had the right to modify their taxation systems at any moment). As a rule, security of tenure was low because of complex and lengthy granting procedures that did not provide enough guarantees to titleholders, mainly during the transition from exploration to mining licenses.

2. Approach

- *Legal framework.* In 1993 Argentina's 23 provinces agreed on a federal pact for the mining sector. The pact:
 - Redefined the role of the state as regulator and facilitator in the development of the mining sector

- Introduced guarantees for fiscal stability, unifying the fiscal regime for all of the provinces
- Established uniform cadastral rules, introducing the first-come-first-served principle as the basis for granting licenses and guaranteeing security of tenure
- Established compatible databases that allow consolidation of publicly available information and publishing of that information at the national level (see <http://www.noalamina.org/>).

While each province continued to be responsible for the granting and monitoring of licenses, compatible procedures allowed the development of broadly homogeneous CCSs nationwide. While it once took years to obtain licenses, it is now, in principle, possible to issue documents in a matter of a few weeks.

- *Institutional framework.* The 23 provincial cadastre units have been modernized and equipped on the basis of common principles. For generations, high education and scientific levels and the management capability needed to implement sophisticated work programs have been available. There is also a long-standing civil service tradition of quality making it possible to offer career development opportunities to qualified staff. While there may be instances of political interference, the technical level of executives is reliable overall.
- *Cartographic infrastructure.* Argentina's cartographic infrastructure is limited. Until recently, the available topographic maps were obsolete and inaccurate, particularly near the border with Chile where the mineral potential is highest and geodetic conflicts frequent, including three different networks that were not linked to each other and were not updated to allow the use of GPS. These challenges often required mining companies to use local coordinates, which were not compatible with a single and unified topographic base and generated frequent overlaps and legal conflicts. To address this issue, the national and provincial authorities in Argentina, with support of a World Bank loan:
 - Revised the geodetic network, updating the infrastructure for the use of GPS technology ¹²
 - Produced geo-referenced ortho-images, based on the adjusted geodetic network, to correct the errors resulting from the available topographic maps
 - Accurately pinpointed the boundaries of existing licenses, marking them properly in the field, and dealt systematically with identified location conflicts

3. Achievements

The results of this new policy and technical improvements have included: (i) a sharp increase in the number of foreign companies operating in the country—from only 4 in 1989 to more than 80 today; (ii) the development of several world-class deposits, including Cerro Vanguardia, Salar del Hombre Muerto, Veladero, Pascua-Lama, Bajo de la Alumbrera and Rio Colorado; and (iii) an increase in investments into the billions of dollars and a proportional increase in exports. Mining activity has dramatically improved the economic situation in some traditionally less developed areas, such as in the provinces of Catamarca or San Juan.

¹² It is important to note that the benefits of this topographic development were not restricted to the mining sector; but represented a substantial improvement for any activity where the use of accurate maps and GPS are required, including road infrastructure, forestry, agriculture, land use, environmental conservation, and so on. This work was coordinated with the official agency responsible for the production of maps in the country.

Figure 14. Evolution of the Argentinean Mining Sector, 1991–2007

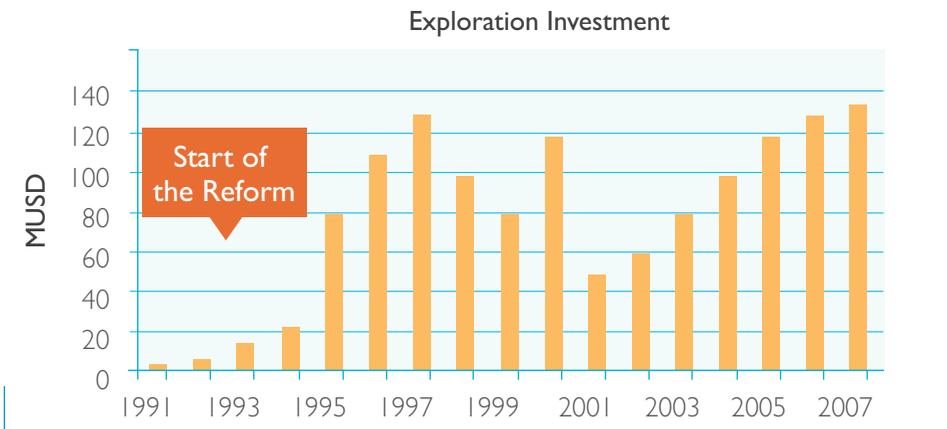


Figure 14 shows the evolution of the mining sector in Argentina during the period 1991–2007. In the early 1990s, mining activity in Argentina was restricted from small- to medium-size exploitations for borax, uranium, tin, and silver. The production of building materials around the most important urban centers, such as Buenos Aires or Córdoba, represented the bulk of the sector outputs. Today, the Argentinean mining sector is well developed and diversified, contributing significantly to the national economy and, in some provinces, representing the main source of income. The contribution to GDP of the nascent Argentinean mining industry has increased from 2.5 percent in 2001 to 6.0 percent in 2006. From few active mines in 1995, there are presently 10 large-scale mines in operation (copper, gold, lithium, silver, lead, zinc, and others), representing a value of production of about US\$4.5 billion (2007).

This remarkable growth in the mining sector is due to a holistic approach to the modernization of the legal and institutional frameworks. Implementation of the new cadastre, which increased security of tenure, represented the cornerstone for the new regulatory and institutional setup; its contribution to attracting and stimulating investment has been critical.

4. Areas for further development

The Argentinean mining sector is currently operating well on its own. The main challenge is to ensure sustainability at the same level in all provinces over long term, as well as to maintain the infrastructure capacity and modernization through time.

C. Democratic Republic of Congo

1. Background

The DRC has an enormous mining potential, as evidenced by its position in the history of metals production at the global level. Together with Zambia, the DRC is home to the famous “Copper Belt,” and the country was one of the world’s largest copper producers until the 1970s. Mainly due to conflicts and ineffective sector and investment policies, however, mining production declined sharply during the latter part of the 20th century. The unstable political situation in the DRC during the last decades stalled mining investments.

Yet the country's tremendous potential, not only for copper, but also for gold, diamonds, base metals, and other minerals has always generated interest among investors, who consider the DRC to be one of the more promising countries in the world. Even during times of maximum risk and difficult conditions, such as during the civil wars, a few companies still developed exploration projects.

In addition to the social and political problems, the administration of the mining sector did not substantially mitigate investment risks. The lack of clear and transparent procedures for granting licenses, and the lack of an efficient MRC reduced the security of tenure for mineral rights. There were a number of conflicts and reclamations even at the international level. The situation was made worse by the fact that all cadastral activities were centralized in Kinshasa—with a land area of 2,344,885 km²—and far from the capital.

2. Approach

- *Legal framework.* Reform of the DRC's mining sector began with the enactment of a new Mineral Law in 2002, which introduced the conceptual basis for a transparent licensing methodology, including specific procedures for confirmation of the old mineral rights and resolution of conflicts.
- *Institutional framework.* The resolution of conflicts and consolidation of existing mineral rights, immediately followed by the approval of licensing regulations and implementation of a new, computerized Mining Title Registry and Cadastre Service (CAMI) in 2003, significantly improved licensing conditions in the country. In addition, some attempts at decentralization have been realized (a cadastral office is now open in Lubumbashi).

The DRC has a comparatively low institutional capacity and civil service tradition in managing the mining sector, and there is a strong dependency on foreign financial support. Nevertheless, at the technical level, this dependency is less significant, at least for the mining sector, because of the accumulated experience in exploration and exploitation activities.

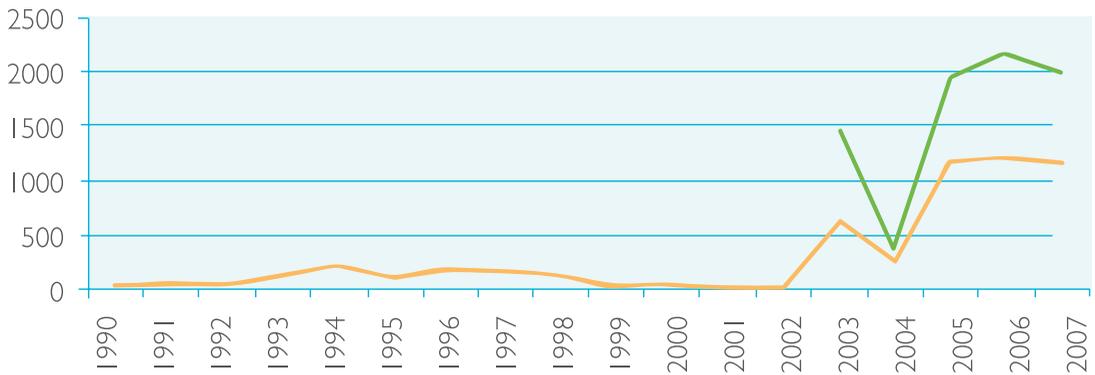
- *Cartographic infrastructure.* Like several of the countries described in this chapter, the DRC had serious geodetic and cartographic limitations. The geodetic network had not been updated to allow the use of GPS and the available topographic maps are not homogeneous, preventing the accurate representation of license boundaries on the maps and the accurate use of GPS, leading to frequent cadastre conflicts. In a country as large as the DRC, with an almost nonexistent access infrastructure, there is no simple and short-term solution. A first step has already been taken with the revision of the geodetic network in the southern part of the country.

3. Achievements

The implemented reforms immediately produced a positive impact, with an increase in security of tenure. The fact that they coincided with the end of a civil war also helped. Figure 15 shows the evolution of cadastral activity since 1990 and clearly illustrates the immediate positive effects of a combination of socio-political normalization and cadastre implementation. Although the number of license applications (green line) between 1990 and 2003 was not registered or not preserved,¹³ it can be assumed that the level of applications was similar to that of granted licenses (orange line), as seen between 2003 and 2007, when data are available.

¹³ To give an idea of the security of tenure at that time, licensing offices were pillaged two times during that period.

Figure 15. The Evolution of License Applications (Green Line) and Granted Licenses (Orange Line) in the DRC, 1990–2007



The benefits derived from the implementation of the new legal framework and the new cadastre can clearly be seen in Figure 15. Today, the DRC's mineral rights are managed by a modern and efficient institution, well organized, with trained and capable staff. In spite of some technical troubles with software that is going to be replaced, CAMI is a reasonably well-equipped computerized cadastre. Furthermore, in line with the enacted legal framework, the cadastral procedures are effectively designed to encourage transparency and guarantee respect for the first-come, first-served approach.

4. Areas for further development

Despite the positive results described above, there are still several issues to address that may improve CAMI's performance.

The level of cadastral activity (and attractiveness) is still low relative to the country's metallogenic potential. The number of applications in DRC is similar to that in Madagascar. Taking into account the difference in size between the two countries (the DRC is nearly five times the size of Madagascar) as well as the difference between the known potential resources, the number of applications in the DRC should be much higher than in Madagascar. One of the reasons may be the low level of decentralization in the DRC, which only recently began and needs further improvements.

Until recently, CAMI was economically sustainable due to mineral rights management fees. The government decided in 2008 to change this situation and the fees are now transferred to the central treasury, making CAMI dependent on political fluctuations.

A number of instances of political interference in cadastral management are another factor limiting CAMI's performance. In order for the DRC to realize its full mining potential, CAMI would have to increase its level of operational autonomy, while simultaneously increasing its transparency, sustainability, and efficiency.

D. Ghana

I. Background

Since independence from British rule in 1957, industry-friendly policies were seen as the means to modernize and develop the Ghanaian economy. But spurring economic growth through industrial development was a challenge for the country. Industrial contribution to real GDP was, by the early 1980s, at its lowest level since independence, and the Ghanaian mining industry was in dire condition. In 1983 the government launched an Economic Recovery Program (ERP), including reform of the legal and regulatory framework for mining. In 1986 the new Minerals and Mining Act was adopted, and the Minerals Commission was created. The new legal framework was interpreted favorably by investors: front-end taxes and import/export levies were removed, corporate tax was reduced and, with the aid of the International Monetary Fund (IMF) and the World Bank, several state-owned mines were rehabilitated (and, in the mid- to late 1990s, eventually privatized). Between 1986 and 1989, over 55 gold prospecting licenses were issued, and 3 gold mining companies commenced production in the late 1990s. As a result of the improvements in the investment climate for mining, Ghana was voted among the top 10 emerging markets for mining (the only African country to be ranked so high) in a 1995 survey of international mining analysts.¹⁴ By 2004 the mining sector had received significant amounts of new foreign investment, with nearly a seven-fold increase in annual gold and bauxite output and significant increases in diamond and manganese production. But this expansion brought substantial costs—including resettlement of local populations, environmental harm, artisanal mining—and too few benefits to local mining communities. In 2006 the government initiated a new generation of reforms to remediate this comparatively low level of investment, as well as to improve the performance of the sector to better contribute to the socio-economic development of the country and to protect the environment.

Updating the MRC was not initially prioritized as part of the reform program. In spite of the recent commodity boom, the level of cadastral activity in Ghana was lower during recent years than during the late 1990s, suggesting that the positive impacts expected from the new 2006 law have not yet fully materialized. Figure 16 shows the evolution of cadastral activity since 1990. The orange line represents the total number of granted licenses and the green line the number of those granted for reconnaissance and exploration (an indicator for investment sector attractiveness). Three different periods can be identified: a growth phase from 1990 to 1997–98, a sharp fall from 1998 to 2000, and a new growth phase from 2000 to the present. These periods are correlated with the evolution of metals prices, mainly for gold. Nevertheless, although the prices for gold and almost all mineral commodities were exceptionally high from 2006 to 2008, the level of cadastral activity has not reached the late 1990s level.

¹⁴ *Business in Africa*, August–September 1997.

Figure 16. Licenses Granted for Reconnaissance and Exploration (Green Line) as a Proportion of Total Granted Licenses (Orange Line) in Ghana, 1990–2007



2. Approach

- *Legal framework.* In 2006 a new Minerals and Mining Law was enacted introducing the principles for a new licensing methodology. But the drafting and approval of specific licensing regulations was delayed and are still under preparation.
- *Institutional framework.* The entity responsible for the management of mineral rights is part of the Minerals Commission, an institution created in 1992 that demonstrated a considerable level of sustainability, adequate staffing, and efficient sector management. A clearer assignment of responsibilities regarding licensing management and monitoring of operations would help the Minerals Commission optimize its organizational setup and improve the efficiency of title administration.
- *Geodetic infrastructure.* The Government of Ghana has initiated a program to solve the technical difficulties linked to the geodetic network and the topographic base maps. The network is currently being updated and accurate GPS measurements should soon be possible over the whole territory. It will allow the accurate representation of license boundaries on maps and GIS, which would help to eliminate potential cadastre conflicts.
- *Computerization.* Ghana's MRC was one of the first African cadastres to be computerized (1999) and it is equipped with excellent hardware and software. Computerization was implemented before the current revision of the cadastral procedures, however, and the system is affected by significant problems linked to registry and data management. As a result, the effects of computerization on the performance of the cadastral management—understood as a fully integrated mineral rights management system—are poor. The completion of the project to improve the geodetic network and to establish the mineral rights regulations will provide the necessary basis to update and streamline the CCS with the new legal framework.

3. Areas for further development

The evolution of the Ghanaian MRC demonstrates that (i) the preparation of regulations and procedures is critical to effectively implement sector reform or improvements introduced through the passing of a new Mining Law; and (ii) the development of a computerized management system has to be based on approved, legally and technically clear regulations and procedures. The Government of Ghana is presently implementing a program addressing the present constraints and there is no doubt that the country will soon see the benefits of a modern and fully functional MRC.

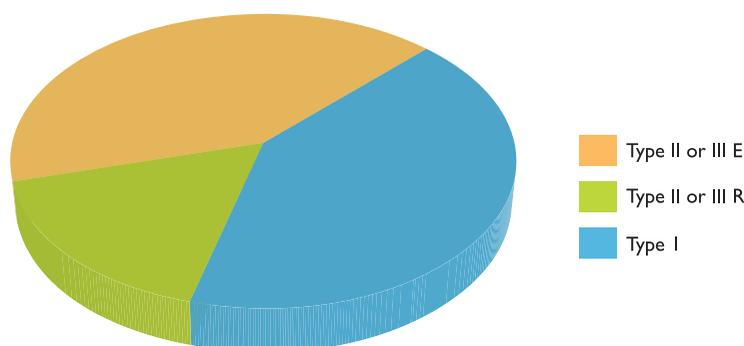
E. Madagascar

I. Background

In the late 1990s, the main mining activity in Madagascar was artisanal, with a few small- to medium-scale operations, all of which had a low impact on the national economy. National institutions were not equipped to deal with large-scale mining; the state needed to adapt to the role required in a developed mining sector. Staffing sector institutions was problematic and political interference, coupled with managerial shortcomings, made mining sector development very difficult.

The cadastral activity and the methodology followed for granting mineral rights licenses were, in particular, negatively affected by the shortcomings in the legal system. The enacted legal framework allowed the registration of overlapping applications (with the government having the right to later choose the “appropriate” titleholder), and cadastral files and maps were kept secret from the public. As a result, the granting procedures were highly discretionary, the security of tenure was very low, and the investments were very risky. Thus, despite the favorable geology of the country, investments in exploration were very low.

Figure 17. Distribution of Mineral Rights Licenses in 1999 in Madagascar, before the Approval of the New Mining Law and the Implementation of the New Cadastre



Another negative consequence of the inadequate legal framework was in the distribution of mineral licenses. Figure 17 shows the breakdown of mineral rights licenses in 1999. Small-scale licenses (Type I), valid for both exploration and mining, made up approximately one-third of total licenses. Among the other licenses, exploration titles (Type II or III R) were in minority compared to the exploitation licenses (Type II or III

E), which represented nearly one-half of the total. This distribution, illogical from the point of view of exploration and mining activities, indicated an absence of an efficient system of annual surface rental fees leading to speculation.

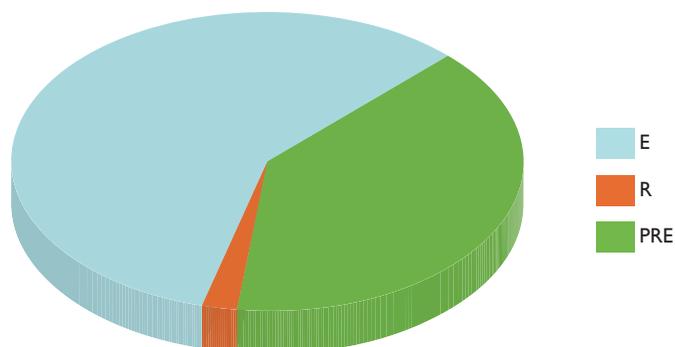
2. Approach

- *Legal.* Reform of the mining sector in Madagascar began with the enactment of a new mining law in 1999, followed immediately by the approval of new regulations and implementation of a new cadastre and new licensing rules, on a first-come, first-served basis with a system of progressive annual surface rental fees. The 2005 amendment to the mining law introduced the option to auction available areas with existing information on mineral resources or reserves. The auctioning process was managed by the cadastre office.
- *Institutional and organizational.* At first, the country established a centralized “paper” cadastre, followed by computerization and, later, decentralization to computerized regional offices. The cadastre was created as an external entity, reporting directly to the minister. The new entity was economically independent from the ministry budget.

The Madagascar Mining Cadastre Bureau (BCMM) is a good example of effective organization, adequate decentralization, and sustainability. It was created as a decentralized entity, with seven offices (one central office with six regional offices) that were integrated into an autonomous agency (“public company”) reporting directly to the minister responsible for mines (but outside the ministerial structure). Furthermore, the implementation of a “mobile cadastre” has allowed it to reach remote artisanal mining areas and has contributed to improvements regarding the legalization of this important subsector regarding the production of gold and gemstones.

Since its creation in 2000, the BCMM, empowered with the capacity to manage its own income, has demonstrated its sustainability by generating enough revenue to hire qualified staff required for the job and to properly develop its cadastral responsibilities. By eliminating cadastral conflicts, the BCMM demonstrated its functional competence, supported by a computerized system facilitating data management and data exchange between central and regional offices.

Figure 18. Distribution of Mineral Rights Licenses in Madagascar in 2001, after Approval of the New Mining Law, the Implementation of a New Cadastre and Achievement of the Transitional Measures



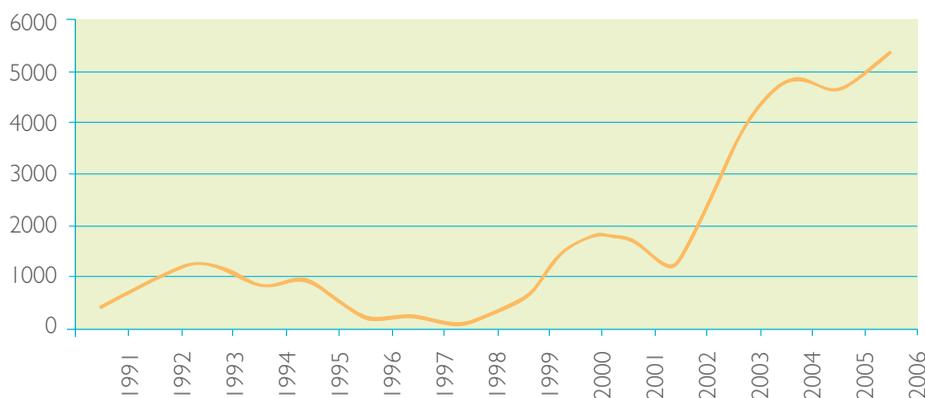
3. Achievements

The success of the sector reform shows the importance of implementing—when feasible—an integrated policy, legal, and institutional approach. The establishment of the new cadastre was followed by the creation of a Gemology Institute (necessary because of Madagascar's gemstone wealth) and a computerized environmental management unit. The country also embarked upon the production of new geological maps and the generation of a geological and mining database. The institutional reform, focusing on reorganizing the ministerial structure, will be completed with the establishment of a modern GS and a mining inspectorate.

The implemented reforms improved the country's mining sector performance. The first impacts were seen in the distribution of mineral licenses. As can be seen in Figure 18, which shows the distribution of mining licenses in 2001, small-scale licenses (PRE) continued to represent approximately one-third of the total, while exploration titles (R) constituted a large majority compared with exploitation licenses (E).

The opening of the cadastral files to public consultation and the application of objective and transparent cadastral procedures have increased the security of tenure and the attractiveness for investment. This change is clearly reflected in the increase of the number of cadastral applications per year (see Figure 19), which statistically can be considered as directly proportional to the level of investment in exploration.

Figure 19. Number of Cadastral Applications in Madagascar, 1991–2006



In general, cadastral management by BCMM has been free from political interference and has contributed to the surge in mining investment in Madagascar. As of late 2008, two world-class mining projects have been launched, making Madagascar a true mining country. Additionally, BCMM has demonstrated its sustainability through expansion (three new decentralized offices opened in 2008) and modernization of its computing equipment with its own financial sources and without external support.

4. Areas for further development

The success of Madagascar's mining sector still needs to be consolidated and stabilized. The cadastre has demonstrated its sustainability from an economic and technical point of view, but it still faces challenges from the institutional point of view. Avoiding distortions in the interpretation and application of the legal framework, as has recently been

seen in a few isolated anomalous activities, will be one of the principal challenges. Currently, ongoing institutional consolidation is the next step in project implementation.

Another area of potential improvement concerns the high occupancy rate of mineral lands combined with the relatively low rate of exploration or development investments. The introduction of more adequate escalating fee would likely solve this issue.

F. Mauritania

I. Background

The recent history of cadastral activity in Mauritania is very similar to that of Madagascar, though with different results. Until the late 1990s, the country did not have a diversified mining tradition, though the sector was a large part of the economy. The iron ore deposit exploited by the state-owned mining company was the only large operation, while some small-scale quarry operations were also in operation. The country was in need of institutional reform to improve its mining sector performance. The cadastral activity was virtually nonexistent and proper cadastral maps or registry books were not available. Without a clear legal framework and without clear cadastral procedures, granting procedures were highly discretionary, security of tenure was low, and investments were considered too risky.

Furthermore, as in the case of Argentina, because the network had not been updated to allow the use of GPS, there were also geodetic limitations. Correct representation of license boundaries on maps was difficult, potential cadastre conflicts were possible. As a result, despite Mauritania's favorable geology, there was a low level of exploration investment.

2. Approach

- *Legal.* Reform of the mining sector in Mauritania began with the enactment of a new mining law in 1999, followed immediately by the approval of new regulations and the implementation of a new cadastre and new licensing rules on a first-come, first-served basis and establishing a system of progressive annual surface rental fees. The implementation began with a "paper" cadastre, followed by computerization.
- *Institutional and organizational issues.* The cadastre was created as a directorate inside the ministry responsible for mines. From the institutional point of view, the Mauritanian cadastre is centralized (the limited level of activities does not now justify the opening of decentralized offices), integrated as a directorate inside the ministerial structure. Although this organizational structure is efficient from the operational point of view, it lacks sustainability. Eight years after the creation of the new cadastre and in spite of substantial revenues produced by the annual surface rental fees (more than enough to cover operational costs for management of the whole mining sector) the cadastre is still not sustainable. The underlying reason is the fact that the cadastre revenues are processed by the Ministry of Finance and so the MRC office has no access to them. This budgetary arrangement limits the ability to consistently cover the salaries of trained cadastre staff.
- *Infrastructure issues.* To solve the technical obstacles to positioning mineral rights, the geodetic network has been updated to allow the use of GPS technology, using an algorithm to transform the national map coordinates into the GPS system coordinates and vice versa. Access to this algorithm has been opened to the

public in order to facilitate the use of GPS not only for the mining sector, but also for any other activity, including forestry, agriculture, land use, environmental conservation, and so on.

3. Achievements

As part of integrated sector modernization efforts, the implementation of the new cadastre was followed by institutional reform in the ministry in charge of mining, establishment of a computerized environmental management unit, production of new geological maps, and generation of a geological and mining database.

Implementation of these activities introduced important changes to Mauritania's mining sector. As shown in Figure 20, cadastral activity, as represented by the number of applications per year, increased sharply. Cadastral activity before the opening of the cadastre was practically nonexistent, and even with the recent dramatic rise in 2006 (closely linked to the increase in metal prices) to about 200 applications per year, the total is still relative low for the country's size and geological potential.

4. Areas for further development

Implementation of the new legal framework and establishment of the new cadastre, including the opening of the cadastral files to public consultation and the application of objective and transparent cadastral procedures on a first-come, first-served basis increased the security of tenure. Investor interest in Mauritania's mining sector increased. In absolute terms, however, these improvements translated into a moderate success, with only two new medium-scale exploitation projects in the country. Political instability led to significant interference with cadastral activity, as is clearly seen in Figure 20, which shows a clear divergence between the number of applications and the number of granted licenses since 2004 (particularly since 2006).

Figure 20. Difference between the Number of Applications (orange line) and the Number of Granted Licenses (green line) in Mauritania, 2000–2008



In general, the new cadastre in Mauritania generated positive mining sector impacts by attracting many companies and sharply increasing the level of exploration. A number of challenges still remain for the organization. Currently, the main issue for Mauritania is to improve the institutional organization and sustainability of the newly created cadastre.

G. Mongolia

1. Background

An interesting cadastral experience and a complementary case to the Algerian example is that of Mongolia. Mongolia's economy is marked by its recent transition from a Soviet-style centralized system to a market economy. From the mining industry point of view, the sector institutions are relatively well developed, experienced, and perform reasonably well. The country has a number of important deposits in exploitation during the last decades.

2. Approach

- *Legal.* As part of the political evolution described above, a new mining law was promulgated in 1997, establishing the basis for a new method of granting licenses on a first-come, first-served basis. Although this law has not yet been completed by detailed licensing regulations, new cadastral procedures were developed, and a specific, partially computerized administrative unit responsible for licensing activities was created.

In 2006 the 1997 mining law was amended, affecting the security of tenure and creating new risks for titleholders. For instance, the amendment created a category of mineral resources called "strategic deposits" in which the state had the right to have a stake of up to 50 percent at the exploitation stage without the obligation to invest correspondingly. In addition, the 2002 approval of the "law on the licensing for business activity," which included the mining sector, introduced the agreement of the local administration (governors) as a precondition for granting mining titles, leading to interference in licensing.

- *Institutional issues.* Qualified mining sector professionals are not difficult to find, and management capability is available to facilitate work program execution and reform implementation. Nevertheless, there is a need to modernize the organizational structures, redefine the role of the state in the mining industry (the transition to the market economy has not been easy or quick) and better define inter-institutional relationships to improve efficiency. In terms of cadastral organization, cadastral activities are included in an autonomous agency responsible for the management of mining, oil, and gas resources (until recently, there was no ministry responsible for the mining sector, which was instead managed by the Ministry of Trading). Inside this agency, there is a dilution of cadastral responsibilities among different entities, mixing licensing and monitoring responsibilities, and generating considerable risks related to security of tenure.

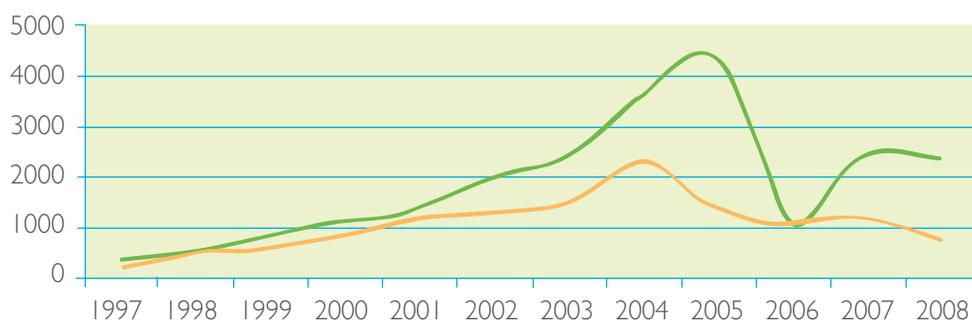
3. Achievements

The positive effects of the implemented legal changes were immediately apparent after the enactment of the 1997 law, as can be seen in Figure 21, where the number of applications is shown in green and the number of granted licenses in orange (information about applications before 1997 is not available). Approval of the 1997 Minerals Law marked a "take-off" of the mining sector, increasing activity and initiating

a continuous growth period, which reached its peak in 2005. But the amendment of the law in 2006 impacted the sector very negatively.

Figure 21 also shows the effects of the 2002 “law on the licensing for business activity.” The comparison between the evolution of granting (orange line) and applications (green line) demonstrates the negative impact of this law on the evolution of the licensing activity. In fact, the ratio between the number of applications and granted licenses may be considered to be in line with international standards between 1997 and 2001 where the number of licenses granted is slightly lower than applications. Nevertheless, after 2002, the percentage of rejected applications increases sharply, reaching extremely disparate values in 2004 and 2005.

Figure 21. The Evolution of Mining Applications (green line) and Granted Licenses (orange line) in Mongolia, 1997–2008



The anomalous situation in 2006 is due to a cadastre moratorium, when the office stopped accepting new applications for nine months. It is important to note that after reopening, the level of activities never recovered to the rates established in 2005 before the amendment of the law. It should also be noted that a policy interpretation of the law provision regarding what constitutes “mineral discoveries” determined through state-funded GS works, is redirecting standard applications that would normally be granted on a first-come, first-served basis toward tender bid [[OK?]] procedures instead. This interpretation generates an unbalanced approach toward licensing procedures and is affecting the security of tenure.

4. Areas for further development

The Mongolian experience clearly illustrates how sensitive mineral sector investors are about tenure security and how easily and quickly positive developments can be reversed if the fundamental pillars in mining policy and granting principles are modified. Current cadastral management should work to address the recent negative trends. New amendments in the law, approval of specific licensing regulations, improvement and updating of cadastre computerization, and improvement of the institutional organization would all be required in the near term for Mongolia to continue developing its mining sector according to its potential.

H. Zambia

I. Background

Zambia is known for the southern extension of its legendary “copper belt,” and was, in the 1970s, one of the world’s largest producers of copper and cobalt. The country is endowed with an impressive mineral potential and benefits from a long mining sector experience. From the 1970s to the 1990s however, as a result of a lack of investment in the state-owned mining company, Zambia Consolidated Copper Mines (ZCCM), production and related mining sector impact on the country’s economy declined. In the mid 1990s, the government of Zambia embarked on a profound reform of the mining sector, privatizing most mines and properties.

2. Approach

- *Legal framework.* As part of the mining sector reform, a new Minerals Act was prepared and enacted in 1995. The regulations related to the administration of mineral rights (among a number of others) and were not completed until September 2008. The finalization of the regulations was driven by high investor demand and the subsequent government decision to improve the management of mineral rights. Up until then, the different cadastral offices (Lusaka, Kitwe, Livingstone, Chipata, and Mkushi) applied a blend of old procedures and non codified interpretations based on the 1995 mining law. The new regulations include specific procedures for licensing (registering of applications, geometry, and geographical marking of licenses, and so on), but have not yet been fully implemented. In response to public pressure, the Minerals Act was repealed and replaced in 2008, which, amongst others, abolished the Mine Development agreements, provided for non exclusive licenses and review of all applications by the Mining Advisory Committee (MAC).
- *Institutional framework.* Licensing is now the responsibility of both the Director of Mines and the Director of the Geological Survey, under the Ministry of Mines and Minerals Development (MMMMD). The technical capacity of ministry staff is generally very high, but at times it is hindered by the difficulty in recruiting and retaining staff and a number of organizational dysfunctions. Following the passage of the 1995 Minerals Act, the MMMMD was not restructured, and a number of difficulties related to the decentralization process arose. The Zambian MRC consists of one central and potentially nine decentralized provincial offices. The respective functions, responsibilities and requirements of each office are not yet clearly defined. The existing communications system does not allow for an adequate exchange of data among the central and regional offices. These conditions, along with a number of shortcomings in the applications registry and cadastral maps, have delayed implementation and generated several conflicts and reclamations.
- *Geodetic infrastructure.* The geodetic network has been recently updated to address cartographic location problems for licenses and allowing for the use of GPS technology over the whole Zambian territory. As in Mauritania, access to information for transformation of GPS to cartographic coordinates is available to the public in general, in order to facilitate the use of GPS not only in the mining sector, but also for any other activities. A specific geodetic campaign was completed in Zambia for the calculations of the required algorithms
- *Computerization.* The Zambian MRC has recently been computerized and updated to accommodate the 2008 Mines and Minerals Act, and, although the selection

of hardware and software has been adequate, the designed system does not fully contribute to an improved management of the mineral rights, imposes a considerable administrative burden in redefining numerous existing irregular licenses under the new 6 second cadastre unit system and supporting the MAC due to the above mentioned regulatory and institutional deficiencies.

3. Areas for further development

Zambia currently faces the following challenges to improving administration of its mineral rights by: (i) the developing of procedures that would reduce potential interferences in the sometimes cumbersome decision-making process, (ii) establishing reasonable operational and financial autonomy and (iii) creating an institutional structure that allows for an adequate sharing and coordination of data between the central and regional offices. The recent progress implementing the geodetic network and the development of a modern computerized management system would then benefit the country and allow for reliable management of mineral rights.



ANNEX I. Historical Note on the Origin and Evolution of the Mining Cadastre

Exploring the roots and origin of the term cadastre can help to shed light on why such an institution, devoted to the management and control of properties, has been necessary since the very beginning of history.¹⁵ As soon as the concept of private ownership of property appeared, it became obvious that some sort of system was necessary to register and list properties for two reasons:

- To establish taxation units for the state or kingdom
- To ensure security of ownership to the titleholder, through publicity and transparency; such publicity meant an official recognition of the property or right, which could help avoid potential duplications (more than one owner for the same right) or overlapping properties

A similar evolution took place with early cadastre activities in the mining sector, although this history is much more recent. Management of mineral rights became necessary as soon as mining developed into a commercial sector with associated trading activities. This evolution, which probably began in the Bronze Age, was later spread by the Phoenicians around the Mediterranean Basin and first recorded in Greece, where, by 500 B.C., an early version of today's modern mining cadastres was already operating, distributing mining royalties among the citizens of Athens.

Since the earliest years of the mining industry, the cadastre has played a key double role: (i) redistributing the wealth derived from mining to society or to the state; and (ii) ensuring security of tenure for holders. The application of these roles has varied substantially throughout history, ranging from monopolistic states (or kingdoms) developing mining activities by themselves to liberal governments promoting private sector participation in mining. Nevertheless, some conceptual principles and basic procedures established in earlier periods remain unchanged today.

During the Greek age, all mines were the property of the state, but exploration was stimulated by rich rewards. The administrative procedures stipulated that applicants had the opportunity to give a name to the new mine, introducing the first precedent of the "applications registry book" and the application of the first-come, first-served principle. After a deposit was discovered, the mines were leased and the rights were considered as a property that was assignable and inheritable. Any royalties generated and paid for the mines were spent on public investment (such as the navy, for instance) and in some cases were even distributed among the miners.

Several hundred years later, during the Roman era, private mining activity was fully implemented and companies owned by multiple shareholders were operating mines. Nevertheless, the entire property of the mines still belonged to the state or the sovereign, depending on the political organization prevailing at a particular moment in time (empire or republic). The individuals were allowed to exploit the mines as leases, in some cases granted to the highest bidder, and in other cases by application of the first-come, first-served principle, which was already clearly legislated along with the payment of royalties. What is particularly interesting is that, during this period, the first rules addressed to promote the activity and to discourage "passive speculation" were developed. According

¹⁵ Some of the first cadastres appeared as early as 3000 B.C., designed to manage land rights for agricultural use in the Nile Valley, during the time of the Pharaohs in Egypt.

to the Roman rules, the holder of an idle mining property was entitled to only one half of the claim, with the other half belonging to the state (although legislation provided the claim holder with the right to purchase the second half).

It is not entirely clear when and how the transition from the sovereign- or state-owned mineral rights to private mineral rights occurred, although it is believed that such evolution was influenced by contacts between the Roman empire and the “barbarians” and Celtic people of Central and Western Europe, where private mining activity was deeply integrated within social and economic tradition since the Bronze Age. In addition to the influences induced by political changes and social evolution (with local or periodic peaks of royal privileges against private mining rights), the “free mining” model was fixed in most of Western Europe. Local customs and uses became progressively codified as rules and laws, and by the 10th century, the independence of mineral rights from ownership of the soil was already recognized.

At this time, cadastral procedures were already extremely precise, giving details on how to distribute the surface to be granted between the discoverer and the state or authorities and how to grant claims to later applicants. The procedures also outlined the geometry and dimensions of the claims, as well as the methodology to mark the claims on the terrain. With local variations, these principles (probably propagated from areas of Germany that are currently known as Saxony and Sachsen-Anhalt), were adopted in the principal mining districts, including the “overseas” areas of Cornwall and Derbyshire, where the more important mining activities were located at the time.

During the Renaissance, mining sector applications and legal frameworks from the Middle Ages remained practically unaltered, as outlined in the magnificent book “De Re Metallica” (Treatise on Metals), written by Georgius Agricola in 1556. Essentially, these same rules were operational in Spain at the end of the 15th century and were consequently exported to the colonial legislation in America, for the management of the frantic exploration and mining activity developed in the New World. However, just as in modern times, interpretation of these principles and rules was not uniform from one country to another. For instance, the Saxon kingdom developed strong state control in production methodology, mainly in technologies to be used for exploitation and metallurgy. On the other hand, in the Spanish kingdom, these technical decisions were delegated to titleholders, while the state’s role was mainly focused on granting of licenses and control of production for taxing.

These differences in the interpretation of the conceptual principles were later passed down from the European countries (Spain, Portugal, England, France, Netherlands, and so on) to their respective colonies. An analysis of the application of these rules and conceptual principles in new legislations of former colonies at the time of their independence in the 19th and 20th centuries is very instructive. One example is the “first” Californian mining law and its particular application in the broader United States mining legislation. The California Gold Rush started in 1849, shortly after the United States acquired California, and when the federal presence there for administration and application of laws was still small. Although the U.S. federal government had laws governing the leasing of mineral land, the miners and prospectors in California organized by themselves in each new mining camp, adopting English translations of Mexican mining laws. These rules were gradually spread to and adopted in all the Western states and codified in the official state legislation. However, these state laws were, in some cases, contradictory and “illegal” in relation to the existing federal law. After serious and contentious discussions between rights holders about the rights of government in

the mineral lands (with the government in some cases bringing in the army to “regain” control of the mineral resources), the U.S. Congress passed a new law in 1866 that consolidated rights in favor of the titleholders (at least for certain minerals, including gold, silver, mercury, and copper). Several years later, in the General Mining Act of 1872, the same rights were extended to any valuable deposits. This is one example of the roundabout way in which some conceptual principles, developed fifteen centuries earlier in Europe and exported to the Spanish colonies (including some interpretations contradictory with the original European legislation), were introduced into the legal system of a new nation.

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ANNEX II. Internal Organization of an MRC

The design and implementation of an effective and efficient MRC will require analysis of the type of internal organization and technical capacities required inside the agency. The MRC team should include individuals who have the following skills:

- Legal training for the interpretation and application of legal and regulatory texts
- Capacity and experience to carry out the administration of mineral rights, including the registration, granting, or cancellation of licenses
- Surveying capacity for cartographic control of the geographical location of licenses, including overlaps and conflicts between adjacent licenses
- Accounting and economic experience for collection of rental fees and management of other payments linked to mineral rights
- Computer expertise required for the use of the hardware and software needed for cadastral management

The organizational structure should be simple and operational, following a model such as the one proposed below:

The Director

As the head of the MRC, the director should:

- Represent the cadastre in all forums
- Prepare the draft budget and present it to financial authorities
- Supervise budget execution and expenditure of available resources
- Oversee the recruitment, hiring, and dismissal of employees, as well as any transfer between departments, units, or regional offices (if applicable) of the MRC
- Manage the operations of the cadastre to ensure the effective execution of the functions with which the MRC is charged

The director should be assisted in the performance of these duties by an administrative unit, as well as heads of the departments or services to whom can be delegated some of these duties.

Technical department (service, unit or equivalent)

The responsibilities of the technical department will be focused on the practical application of cadastral procedures in conformity with the legal framework. These may include:

- Providing assistance and information to the public in relation to the steps involved in applying for mineral rights
- Providing information to the public about the cadastre and the status of mineral rights
- Evaluating the applications in conformity with cadastral procedures, including analysis of potential overlaps
- Issuing license documents
- Maintaining, archiving, and filing cadastre documents, including cadastral maps

- Managing and maintaining the computerized cadastre system
- Conserving cadastral documents and record books
- Geodetic field work (when required) for verifying the boundaries of licenses, in the event of conflict

Legal/Administrative and financial department (service, unit or equivalent)

This department will have responsibilities related to the legal aspects and the economic management of the cadastre, including:

- Checking and accounting of payments (surface rental fees and administrative fees)
- Evaluation of the validity of documents included in mineral rights applications
- Interpretation of the legal framework
- Mediation of conflicts between holders and the administration in relation to mining properties
- If applicable, redistribution of the cadastre revenues in conformity with legal prescriptions

In countries where a decentralization model is adopted, this organizational structure will be repeated (although at a smaller scale) in each of the decentralized regional offices. The size and complexity of these regional offices will depend on the level of transferred and delegated responsibilities, although normally they will be small in comparison with the central office.

It is recommended that only the required number of employees be hired to fulfill cadastral duties and that an oversized staff be avoided. Although overstaffing happens in many countries, experience demonstrates that efficiency is not at all proportional to team size and an excessive number of agents often leads to functional distortions and ineffective performance.

Finally, it is important to note that this structure is independent of the adopted organizational structure for mining management and will be easily applicable to an MRC that is located either inside or outside the ministry.



ANNEX III. Geometry of Mineral Rights

Experience has shown that the adoption of the CU fixed over a standard grid is an extremely useful solution for the problem of overlaps between different licenses or concessions and the conflicts that may stem from these overlaps. In addition, the system increases the optimization of land-use and avoids blocked portions of land that might exist between permits where the distance is smaller than the CU dimensions. But there is no type of CU that has standard dimensions with “universal” validity. The selection of the characteristics of the CU for each country should be made according to the characteristics and infrastructure of that country. Basically, the parameters to be considered in choosing a CU include:

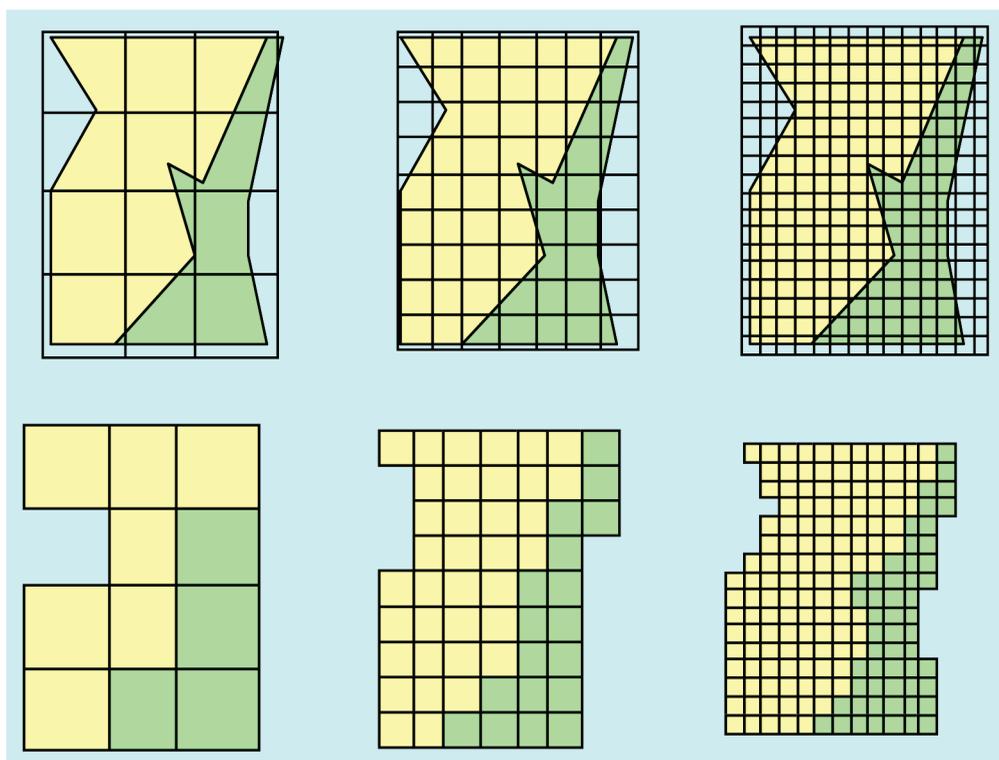
- *Type of grid.* The use of existing coordinates on already available maps (for example, a generic grid) should always be preferred over a mining-specific grid, because it is faster and cheaper to establish, and avoids the tedious and expensive process of redrawing a new grid for the whole country.
- *CU size.* The selection of the dimensions of the CU will depend on the scales and accuracy of available maps and the geodetic framework of each country (for example, the presence of artisanal mining would indicate the need for smaller CUs), as well as on the characteristics of the mining activities in each country and the geometry of any preexisting mining rights.
- *Coordinates delimitating the CU.* The selection of coordinates will depend on which systems have been used in the available national maps of each country. Normally, two or more of the following types of coordinates are represented: (i) geographic coordinates (sexagesimal degrees, minutes, and seconds) based on Gauss cylindrical projection; (ii) metric coordinates based on the UTM projection; or (iii) metric coordinates based on the Gauss–Krügger projection.

Any of these systems can be considered appropriate for mining cadastre purposes. At first sight, the UTM or Gauss–Krügger projections may be considered conceptually ideal for the cadastre, because both are in practical terms “iso-superficial” (that is, each grid unit on the map represents a constant surface area on the earth’s surface) and both are expressed in meters, facilitating the field positioning with GPS. These properties make the management of the CU easier, although the use of these types of coordinates presents difficulties associated with the simultaneous use of several projection zones (mainly in large countries) complicating the use of GIS systems and cadastre computerization.

On the other hand, geographic coordinates are generally not the preferred option, because they do not correct the projection distortions and the grid generated is not uniform (each grid unit on the map does not represent a constant surface area on the earth’s surface). This distortion is not linear, growing in a sinusoidal fashion from the equator towards the poles. This means, in practical terms, that geographical coordinates may be used without major trouble in countries located close to the equator (approximately between latitudes $+30^\circ$ and -30°) where the surface error does not exceed 15 percent. Such a system has been adopted in countries including the DRC and Mozambique.

In addition to the criteria discussed above, another factor to be considered before the selection of the CU size is the complexity of the transitional period for the CU implementation. Normally, when the new cadastral system (including the CU) is adopted by approval of a new mining law or new regulations, the transitional clauses provide the methodology, procedures, and timing for adapting the existing mineral rights to the newly prescribed geometry. If the CU has small dimensions, the geometrical adaptation of preexisting licenses will be easier. Figure 22 illustrates how small CUs (on the right) permit a more detailed adaptation of the geometry of preexisting licenses than larger CUs (left and center). The practical consequence of this more accurate adaptation is a minimization of potential conflicts linked to geometrical changes and the introduction of the CU concept.

Figure 22. Smaller CUs Allow for More Accurate Adaptation of the Boundaries of Existing Mineral Licenses



Of course, this decision is also constrained by the scale of any available maps. The use of small-sized CUs would not be suitable in a country that did not have detailed maps. For instance, a CU with 100 × 100 meter dimensions cannot be applied if the available map is scaled at 1:200,000, because the dimensions of the CU plotted over the map will be too small (0.5 × 0.5 millimeters) to be drawn. Also, the use of smaller

CUs generates the need to handle a large number of units, although this does not have to represent a significant difficulty today, with the support of available computing tools and GIS systems.

The use of the CU system also implies additional restrictions; for instance, any polygon included in the application for a license should be composed of an exact number of CUs, because the CU is indivisible and fractionating is not allowed. Furthermore, all of the applied units should be contiguous at least by one side; two or more isolated polygons or polygons in contact by only one vertex cannot be included together in a single license, permit, or right. In the same way, polygons containing empty spaces inside cannot be accepted. An exception to this rule may be cases where the CU overlaps a national border or the boundaries of reserve areas or other restricted areas; in these cases, the shape and dimensions of the affected CUs will be not modified, but the exploration and mining activities should not be allowed in the areas inside these units where it is not authorized.

With all of these considerations and criteria, it is not surprising that the dimensions of the CU vary greatly from one country to another, depending on local circumstances and particularities (see Table 3).

Table 3. Characteristics of CU Systems Adopted Around the World

COUNTRY	SCALE	COORDINATES	C.U. DIMENSIONS (meters)	C.U. TYPE
ALGERIA	1:50,000	UTM	100 x 100	Generic
BOLIVIA	1:50,000	UTM	500 x 500	Specific
DRC	1:200,000	GEOGRAPHIC	927 x 927 (30" x 30")	Generic
MADAGASCAR	1:100,000	LABORDE (local UTM)	625 x 625	Generic
MAURITANIA	1:200,000	UTM	1,000 x 1,000	Generic
MONGOLIA (proposed)	1:50,000	Gauss – Krügger	500 x 500	Generic
MOZAMBIQUE	1:50,000	GEOGRAPHIC	463 x 432 (15" x 15")	Generic
NIGERIA	1:100,000	GEOGRAPHIC	463 x 456 (15" x 15")	Generic
PERU	1:50,000	UTM	1,000 x 1,000	Generic
CHINA	1:50,000	GEOGRAPHIC	15" X 15"	Generic

ANNEX IV. Computerized Cadastre Systems (CCSs)

A. Information Technology Requirements for Mineral Rights Management

I. Graphical capacity

Using integrated GIS software, the CCS should provide the correct positioning of all mining titles on the official cadastral maps, using an adequate coordinate system and projection parameters. In cases where the country comprises several projection zones (in UTM, Gauss-Kruger, or other multizonal projection systems), the system should be able to simultaneously handle all the projection zones covering the whole country. Furthermore, the CCS should not be limited to “standard” GIS applications and should include (by programming of the cadastral routines) the computerization of all the procedures associated with the administration of applications for and granting of mining titles. In this respect, the CCS should be a custom-built application specifically focused on the particular needs of the MRC in the management of mineral rights, which are conceptually and functionally very different from standard GIS applications for land or natural resources management.

2. Operational and functional characteristics

Operational functions to be developed for the CCS should include:

- The storage, access, and processing of all information required for cadastral procedures, in a quick, easy, and user-friendly way. This should include the integration of graphic and alphanumeric information by means of a specific GIS application, allowing for direct and easy access to the graphic information from the alphanumeric displays and vice-versa. Furthermore, the CCS should facilitate cartographic integration between cadastral information and other layers of graphic data, such as satellite images, scanned topographic maps, or other thematic maps
- Support for the management of mineral rights and licenses by automatic control of the duration and timing for each step in the cadastral procedures; for example, the payment of surface rental fees, license duration, deadlines for renewal or expiration, and any other requirement provided in the legal framework
- Editing and printing of cadastral documents and maps, including official forms, standard letters, graphic documents, cadastral maps, and data lists
- Provision of access to the updated cadastral data (graphic and alphanumeric) for the entire country to MRC agents, as well as to titleholders, applicants, investors, and any other interested people
- Automatic verification of any overlap between licenses and/or applications, as well as consistent control of applied perimeters with respect to the geometric rules (adjustment to the CU, excess of applied area, excess number of licenses, etc.) prescribed in the legal framework
- A guarantee (by internal controls and routines) that order of treatment of dossiers (cadastral analysis during procedures) follows the application sequence, as recorded in the official registry book, and cannot be violated

- Measurement and reporting on the aggregate surface occupied by mineral rights applications and valid licenses in each administrative unit (provinces, districts, and so on)
- Guaranteed security for cadastral information through systematic and automatic application of back-up routines and procedures
- Security tools to preserve the confidentiality, stability, and inviolability of the information in the face of human error and unforeseen circumstances. In this respect, special attention should be paid to the essential cadastral information affecting the priority order of applications, in order to respect the first-come-first-served principle. Different levels of authorization and access to the data for system users should be introduced
- Automatic generation of historic files and an audit trail of the information concerning cancelled or expired licenses and concessions, as well as rejected applications

Besides being a cadastral management tool, the CCS is also a system to measure the evolution of the mining sector and the impacts (positive or negative) of adopted minerals resources policy. In order to continually monitor the health of the mining sector, as well as the efficiency of cadastral management, the CCS should produce statistical data for analysis and the production of standard reports and graphics. This data should include:

Reports and listings of:

- Licenses that are about to expire
- Licenses to be annulled
- Pending payments
- Delayed procedures
- The balance of results for cadastral procedures, detailing percentages of acceptable applications received, and the ratio between granted and rejected applications
- Justification and reasons for applications being rejected
- Statistical distribution of granted licenses per administrative unit (province, district, and so on), including the type of license (exploration, mining, and so on) and type of titleholders (individual, companies, nationals, foreigners, and so on)
- Statistical distribution and accounting of income generated by surface rental fees per administrative unit by type of license and type of titleholders

Statistical graphics representing:

- The distribution percentage for the different types of licenses and mineral rights by number
- The distribution percentage for the different types of licenses and mineral rights by occupied surface
- The distribution percentage for the different types of licenses and mineral rights by mineral substances
- The sequential evolution of applications for new mineral rights
- The sequential evolution of newly granted licenses
- The sequential evolution of valid licenses

- The sequential evolution of surface occupied by mineral rights
- The sequential evolution of income generated by surface rental fees

Technical sustainability and compatibility of the system

In addition to the operational and functional capacities described above, the design of the CCS should take into consideration other informatics features related to the technical sustainability of the system, as well as its operational compatibility with other computerized systems, mainly those linked to the management of the mining sector and the environment. The most important of these characteristics include:

- The system capacity and configuration (hardware and software) should be conceived and developed proportionally to the present situation and the size of the information to be managed (including the storage of historical records). At the same time, the configuration should have sufficient flexibility to absorb any increase in activity level and the architecture of the system should allow for its future expansion when the desired growth of the mining system occurs.
- The system should have a robust and simple configuration, with architecture based on personal computers (PCs) and servers, and standard off-the-shelf and readily supported relational database and commercial software. The digital files should have standard formats compatible with other systems to allow for data exchange (see below), and the application design should be user-friendly, to facilitate the use of the systems by nonexperts.
- The system should be “open” in some of its configuration features, in order to allow its updating in case of changes to the regulatory framework (for example a change in surface rental fees) or if new information is available, such as the GIS data of new information layers from thematic maps or satellite images. However, it is important to ensure that this flexibility does not affect the special information fields relating to application priority and the first-come-first-served principle, which must remain inviolable.
- Although the CCS should be conceived as an independent and autonomous system, this autonomy should not prevent the exchange of data (through the intranet) with other computerized systems related to the management of the mining sector; such as the Geological and Mining Information System (normally placed under the responsibility of the mining directorate and/or GS) or the Environmental Information and Management System (EIMS). Obviously, these capacities should not affect the security and inviolability rules mentioned above. In addition, the system should also have the capacity to export cadastral information that is considered “public” to the internet. Experience has shown that transparency is essential to guarantee the security of tenure and to decrease corruption, and the best way today to increase cadastral transparency is to take advantage of currently available technology and disseminate cadastral information through public websites.

B. Recommended Sequence for Computerization

In order to ensure a smooth transition to a CCS, cadastre computerization should be introduced in three different steps, as described below:

I. Precomputerization phase

The key tasks during this phase involve activities necessary to ensure that data and information is ready for integration into the CCS. These activities include:

- An inventory of the existing mineral rights, verifying consistency between the paper files, alphanumeric information, and the graphic files. The output of this activity will be a detailed list of existing mineral rights as well as a list of any overlapping, conflicting, or irregular situations
- The adoption and implementation (if required) of a new codification system for each individual license, independent of the number of renewals, transfers, or transformations. The new code will provide identifiers for the future GIS structures to link graphic and alphanumeric information. This code will also be used as a basis for a filing methodology, reordering paper documents in order to speed up data retrieval
- Design and implementation of a new alphanumeric database, based on the new codification system, that can be integrated into the GIS system of the future CCS
- Review of the existing cadastral procedures, to determine how they will be affected by the use of the new codification and the new database, as well as by the whole computerization process. If necessary, procedures should be redesigned for computerization, establishing the procedural steps that can be automated or need slight modifications in order to be adapted. This review should cover all cadastral procedures required for the management of mineral rights, including renewals, transfers, mortgages, revocations, and expirations
- Review and, if necessary, redesign administrative forms and other cadastral documentation that will be required for digital treatment, editing, or printing in the context of the computerized procedures
- Review and, if necessary, redesign ,space (rooms) distribution in the office, in order to make it consistent with the new tasks and responsibilities of CUs linked to the computerized procedures.

2. CCS design

Design of the CCS can begin during the precomputerization phase, although it cannot be finalized until the previous stage is complete. It is recommended that design of the CCS be developed in two distinct steps:

- The first step involves development of a prototype that can handle the computerization of the cadastral procedures in full conformity with the enacted legal framework and including all the functions and capabilities described above. The only limitations (with respect to the final version) of the prototype may be the number of users and the data transfer facilities with other computers and systems, because, at least initially, the prototype should be a stand-alone system. After implementation, the prototype should be tested and verified for three-to-six months, in order to allow for debugging and consideration of suggestions for modifications and improvements.

- Based on the characteristics of the revised prototype and the suggested modifications, the second step involves presentation of the system architecture and configuration for acceptance and approval. The final design should include: (i) the technical specifications and quantities of the equipment to be integrated into the system—both hardware and software; (ii) the design of the LAN for MRC and the strategy for communication with the Internet; (iii) detailed back-up routines and security measures, including personalized definitions for the user types and their levels of access; and (iv) plans for training activities for the cadastre team. It is also helpful to include the technical specifications for data transfer (via the intranet and internet) and updating of cadastral information on the website, as well as the preliminary design of this website, at least for the cadastral aspects and information.

3. CCS installation

Once the final design is approved and the required hardware and software has been acquired, the installation and implementation of the CCS will include three different activities:

- *The capture and loading of information.* This activity will involve the transfer of data from existing databases and files (coming from the precomputerization phase) to the formats required by the new system and the new codification, as well as the validation (cross-checking) of the information loaded in the system. If possible, this phase should also include the launching of the cadastre website
- *Test of functionality.* Once the system is installed and the information is loaded, several tests of functionality should be performed, to ensure that the system is working properly. These tests should include verification of:
 - Data retrieval by single or combined criteria (alphabetical, numerical, or geographic)
 - The visualization of graphic and geographic data
 - The capacity for detection of overlaps and irregularities in the geometry of license or application boundaries
 - The ability to automatically calculate the distribution of surface rental fees by administrative units (provinces, districts, and so on)
 - The editing and printing of cadastral documents, including cadastral maps
 - The timing control for all of the procedural steps
 - The control and accounting of payment of surface rental fees and other cadastral fees (if any)
 - The generation of statistical data and the production of standard reports
 - Systems for updating data on the website, the accessibility of the website, and the efficiency of data transfer, if applicable

The final product should not be accepted until all the tests of functionality have been passed satisfactorily. Moreover, it is also recommended that any contract with the consultant responsible for CCS design and implementation include periodic maintenance, supervision, and follow-up of the system for at least 12 months following the end of the functionality tests.

- *Professional training.* Throughout the design and implementation of the CCS, the MRC team should be trained to allow for an effective and efficient transition of staff to their new functions. The training and education activities should be focused on mining cadastre responsibilities, activities, techniques, or functions. Although this training should preferably be completed on the job, depending on the level of cadastral experience and the technical capacity of the MRC team, visits abroad to observe the operation of other cadastres' CCS that are known for their efficiency and performance may also be recommended.



C. Recommendations for Decentralization

Just as the cadastral procedures should guarantee the existence of a unique cadastre with several offices, rather than several cadastres, the CCS should have a unique database that is used by all decentralized offices, rather than several isolated databases. Practical experience demonstrates that the existence of several databases, irregularly updated and independently managed, is always a source of cadastral errors.

The tools required for the communication capacity needed for a unified database are available practically worldwide via the Internet. Although the stability and transmission capacity of the signal may vary, in most cases it is possible to update the cadastral database every 24 hours, as has been the case in Madagascar since 2000 without a single problem or conflict registered during this period. If the Internet infrastructure in the country allows it, the ideal solution for communication among offices is the implementation of a virtual private network (VPN), which permits online connection of the regional decentralized offices with the central office. Using a VPN, a computer terminal operating in a decentralized office can have practically the same access to the database as a computer in the central office.

If these technical and infrastructure conditions are available, then it is easy to guarantee achievement of the first-come-first-served principle that is required to recommend implementation of a decentralized cadastre. However, just as it is not advisable to computerize a cadastre that does not already have a well-organized paper system, it is not recommended to decentralize the cadastre until the CCS is fully tested and operational. Otherwise, the potential problems existing at the central level will be exponentially transferred and increased in the decentralized systems.

ANNEX V. Comparative Table of International Criteria for Mineral Rights Management

Country	Enactment of law	Computerization	Type of granting	Granting power	Cadastre type	Mandatory relinquish.	Minimum work requir.	Minimum invstmt.	Escalating rental fees	Author. overlaps
Afghanistan	2004	In process	Administrative	Minister	Centralized	Yes	Yes	Yes	Yes	No
Algeria	2001	Yes	Administrative	Minister	Centralized		Yes	Yes	Yes	
Angola	1992	In process	Administrative	Council of Ministers	Centralized	Yes	?	Yes	No	Yes
Argentina	1996	Yes	Administrative	Regional Govt.	Decentralized	No	No	No	Yes	No
Bolivia	1997	Partially	Administrative			No		No	Yes	
Botswana	1999	Yes	Administrative	Minister	Centralized	Yes	Yes	No	Yes	?
Brazil	1967		Administrative	DNPM	Centralized	No	No	No	No	
Burkina Faso	1997?	Partially	Administrative	Minister	Centralized	Yes	Yes	Yes	No	Yes
Chile	1998	Yes	Adjudicative	MoJ	Decentralized	No	No	No	Yes	Yes
China	1986	Yes	Administrative	***MOF-COM & MOLAR	?	No	?	Yes	Yes	?
Colombia	1987		Administrative	Vice Minister	Centralized	No		No		
Democratic Republic of Congo	2002	Yes	Administrative	Cadastre	Partially decentralized	?	Yes	Yes	Yes	No
Ghana	2006		Administrative	Minister			Yes	Yes	No	
Guinea	1995	Partially	Administrative	Minister	Centralized	Yes	Yes	Yes	No	Yes
India	1957	Partially	Administrative	State Gov't	?	Yes	N/S	N/S	Yes	?

Country	Enactment of law	Computerization	Type of granting	Granting power	Cadastre type	Mandatory relinquish.	Minimum work requir.	Minimum invstmt.	Escalating rental fees	Author. overlaps
Madagascar	2000	Yes	Administrative	Minister	Decentralized	No	No	No	Yes	No
Malawi	1981	No	Administrative	Minister	Centralized	No	No	No	No	No
Mali	1999?	Partially	Administrative	Minister	Centralized	Yes	Yes	Yes	No	Yes
Mozambique	2002	Yes	Administrative	Minister	Decentralized	Yes	Yes	Yes	?	No
Mauritania	1999	Yes	Administrative	Minister	Centralized	No	No	No	Yes	Yes
Mexico	1992		Administrative	MoCommerce		Yes	No	Yes	Yes	
Mongolia	2006	In process	Administrative	Minister	Centralized	No	Yes	No	No	No
Namibia	1992	Yes	Administrative	Minister	Centralized	Yes	?	Yes	Yes	?
Nigeria	2007	Yes	Administrative	Exp/Cadastre Mining/Minist.	Partially Decentralized	?	Yes	?	No	No
Pakistan	?	No	Administrative	Prov. Secretary	Decentralized	Yes	Yes	No	No	Yes
Papua New Guinea	1992	Yes	Administrative	Minister*	Centralized	Yes	Yes	Yes	No	No
Philippines	1995	Yes	Administrative	Secretary	Centralized	Yes	Yes	Yes	Yes	No
Peru	1990	Yes	Administrative	Cadastre	Decentralized	No	No	No	Yes	No
Republic of South Africa	2002/04	Yes	Administrative	Minister	Decentralized	?	Yes	Yes	?	No
Tanzania	1998	Yes	Administrative	Commissioner	Decentralized	Yes	Yes	Yes	Yes	No
Uganda	2003	In process	Administrative	Commissioner	Centralized	Yes	Yes	Yes	Yes	No
Zambia	1995	Yes	Administrative	Minister	Partially	Yes	Yes	Yes	?	Yes

*There is an exception for the Special Mining Lease, which is granted by the Governor-General of Papua New Guinea.

** A new mining law was going to be passed in December 2008.

*** Ministry of Commerce and Ministry of Land and Resources.

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