

# 1. INTRODUCTION

## 1.1 Extractive industries and governance

The use of natural resources, renewable and finite, for the development of human society is as old as human society itself. With industrialization and modern technology, the extraction of these resources has seen an impressive growth. “While a human in a hunter-gatherer society required around 3 kilograms of biotic and abiotic material in a day, the consumption of a present-day human in an industrial country lies at more than 40 kilograms per day”. (Swiss Academies of Arts and Sciences 2012) With this rise in consumption there is also an increased consciousness of the finite nature of some of these resources. While metals, minerals, and oil in particular can create great riches for those that possess and exploit them there has also been a rising awareness of the multitude of problems they can create if used without care. “Society’s expectations of the sector’s [mining and metals] performance are high and continue to increase. This manifests itself in pressures for higher standards of social and environmental performance, greater transparency, and more participation in decision-making by stakeholders that have historically played only a marginal role.” (ICMM 2012) The question is therefore how to use these resources for the benefit of humanity while limiting or even negating the already recognized negative effects of the extractive industries? The growing consumption of resources coupled with the growth of the human population in parallel increases the pressures on the Earth ecosystem as well as socio-economic pressures in society. Good management of these resources is therefore becoming more important than ever and at all scales: local, regional, national, and global (Ostendorf 2011). Good management assumes knowledge of the process that is being managed. “Science can play an important role by making the effects of the use of natural resources measurable and therefore comprehensible and by interpreting the results of application of these indicators.” (Swiss Academies of Arts and Sciences 2012) The keyword here is measurement; in order to have evidence-based governance and management of natural resource extraction measurement of all the processes, conditions, and effects of this industry is vital.

The International Council on Mining and Metals (ICMM) believes that through “responsible public and private management, the mining and metals industry can contribute to poverty alleviation across the world while maintaining ecosystem integrity” (ICMM 2012). While this may seem as a lofty goal or a case of having the cake and eating it too, it is at least an ideal worth tending to. This work will take a look at theoretical and methodological considerations aimed at helping the extractive industries reach this goal. By looking – among others – at the relatively recent Resource Governance Index (RGI) produced by the Natural Resource Governance Institute (NRGI) as an example of a concrete measure of governance in the extractive industries this work will propose an improved measurement of resource governance based on evidence stemming from the relevant literature.

## 1.2 Research questions and structure

In particular, one can argue that a spatial component could greatly improve the pertinence and insight the RGI gives to its users. Geographic information systems (GIS) have come a great way in recent years and the proliferation of its use in a multitude of domains attests to the potential this technology has to improve analysis of human and natural systems. The extractive industries and the governance of natural resources are a prime candidate for GIS analysis considering the crucial spatial component of these activities. While case studies of specific countries and projects abound in the literature and composite indexes measuring transparency, corruption, or sustainability with a purely numerical score have become more and more popular there is no systematic approach as of yet that integrates all components into a consistent single measure. The main question guiding this work is therefore: ***How can a geospatial component support the analysis of the RGI?*** Stemming from this main question are two working hypotheses that will guide the literature review, discussion, and final recommendations:

- It is necessary to combine several other components with the RGI to produce a more holistic and efficient measure of the governance of natural resources.
- There are existing complementary approaches that can be used in combination with the RGI.

Further sub questions are:

- What are the current gaps and weaknesses of the RGI?
- What are the preconditions or barriers to producing a geospatial component of the RGI?
- What is the appropriate temporal and spatial scale when analyzing natural resource governance?

This work will be structured as follows: a brief methodology section followed by a literature review of the crucial theoretical concepts such as the resource curse, governance, and transparency will place this work in its context and review what are the major currents of thought and problems in this domain, the second part consists of a breakdown of the methodology of the RGI in order to identify gaps and areas of improvement, the third part will present considerations and relevant literature that need to be taken into account when incorporating a spatial component, the fourth part will present an ideal improved measure that builds on the methodology for calculating the RGI and combines other components to create a more efficient indicator, and finally the conclusion will summarize the key messages and findings.

## 1.3 Methodology

This paper is part of the work accomplished for the Complementary Certificate in GIS of Geneva University and is the final step required for the validation of the Certificate. It was written under the guidance of Dr. Pierre Lacroix who is a member of the enviroSPACE lab.

Considering this work had to be done in a two month period, certain aspects were reduced and not analyzed fully in order to stay in line with that deadline. The structure and methodology employed correspond to a literature review report. A read-through of the RGI report and methodology, information available on the website, intent, goals and objectives was undertaken as a first step in order to determine the context of the study. This was followed by a wide scope exploration of all possible sources of relevant literature and information coming from academic sources, NGOs, governments, international press, and stakeholder associations. This step allowed to fine-tune the scope of the study and pinpoint sources on a scale from least to most relevant/specific. This exploratory phase also allowed the identification of specific articles and reports that provided the basis for further reading in a branching out process. Finally the assembled literature was grouped into categories corresponding to different concepts analyzed. On the one hand literature relevant to the theoretical framework of concepts like transparency, governance, and corruption in the extractive industry was sought out and on the other hand literature detailing practical applications of these concepts through instruments like transparency initiatives and indexes was also searched for. GIS tools and practical applications within the context of the extractive industry was the final category of literature analyzed. In light of the literature the RGI methodology was critically analyzed in order to identify gaps, possible improvements, and barriers to improvement. This step was therefore followed by a critical appreciation of the RGI, the development of recommendations based on the literature, and a consideration of possible ways in which a spatial, GIS component could benefit the evaluation of resource governance. Finally, a tentative implementation of a GIS component into the existing RGI structure is proposed as the result of the literature review. This final part presents conclusions and recommendations based on the literature review and shows the different possibilities that further research could explore. Even though many of these aspects merit a more detailed analysis they were not treated in their full extent due to the time constraint of this work.

## **2. LITERATURE REVIEW**

### **2.1 Resource curse**

The concept of a resource curse grew out of economics following observations that countries with abundant natural resources did not develop economically and socially at an expected rate. In other words, growth in resource abundant countries was similar or even lower than in countries with no abundance of natural resources. Sachs and Warner (1995) were among the first, following an influential report funded by the World Bank in 1988 and a seminal book by Richard Auty in 1993 (Gilberthorpe and Papyrakis 2015), to demonstrate a lower growth in resource rich countries and identified the Dutch disease<sup>1</sup> as the main mechanism responsible for this dynamic. However, the observed effect was not present in all resource rich countries and some struggled with the curse much more than others, which

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<sup>1</sup> A precursor to the resource curse concept, the Dutch disease concept is based on the Dutch experience of one economic sector developing at the detriment of others after the discovery of a large gas field (a rise in export rents causes an appreciation of the domestic currency that makes the non-resource sectors less competitive, undermines growth, and puts inflationary pressures on the economy (Mejía Acosta 2010)).

lead to the question of how exactly would the mechanism of the resource curse work. Corrigan (2014) presents a summary of the historical and methodological development of the resource curse research and analyzes some very important measurement questions (looking at resource intensity versus gross production versus per capita output for example). Shaxson (2007) provides some of the earliest examples (Equatorial Guinea, Angola, and Nigeria) that spurred the debate and confirmed the existence of a resource curse in some countries. Mejía Acosta (2010) provides a brief overview of the main findings and arguments in this domain. It is not within the scope of this work to discuss all the details and intricacies of the resource curse but rather to use it as a starting point in order to understand why resource governance is important.

What started as a purely economic analysis looking at a possible causal link between resource abundance and GDP growth soon branched out into many other domains and researchers started looking at other factors that could be linked and affected by a large extractive industry sector. Corrigan (2014) traces the evolution of research on the resource curse from a focus on economic variables and effects to a broader scope looking at institutional quality, corruption, conflicts, and governance. Inspired by countries like Norway and Botswana, some authors (Mehlum et al. 2006, Sala-i-Martin and Subramanian 2003) found another variable that influences the effects of resource abundance: “They find that natural resource abundance has a negative effect on institutional quality and that institutional quality has an impact on growth” (Corrigan 2014). It follows that there are two main factors that determine the economic impact (we will later look at environmental impacts as well) of the resource curse: the abundance of natural resources in a country and the quality of its institutions. Furthermore, considering that “a country has little control over the quantity of resources within its borders, the quality of institutions is, therefore, the most critical determinant of outcomes” (Corrigan 2014). This realization turned into a proliferation of research on governance, transparency, and corruption as related to resource abundance because these variables seemed to directly impact or be impacted by resource abundance. Shaxson (2007) provides a good overview of some of the seminal works from the 1990s research into governance and corruption and Corrigan (2014) documents studies that found tangible negative effects of resource abundance on democracy, institutions, conflict prevention, and corruption. Others also talk about the resource curse as a prelude to their research into some of the other concepts (Kolstad and Soreide 2009, Kolstad and Wüig 2009, Cust and Poelhekke 2015, Kaufmann 2015).

It is worth pointing out that some researchers highlight the link between resource abundance, corruption and state failure but also argue that the negative consequences of the resource curse are not predetermined and some countries have avoided them (Kaufmann 2015, Barrett et al. 2005). Some more recent works, including arguments against criticisms, on the resource curse and how it affects governance include Büsse and Groning (2011) and Kolstad and Soreide (2009). Frankel (2010) explores the concept and the different literature strands as well as possible causal mechanisms in depth. For a more recent

review of resource curse literature across different disciplines and scales consult Gilberthorpe and Papyrakis (2015).

### 2.2 Governance

Governance has therefore been identified as a very important variable when talking about how nations use their natural resource riches since it was shown that weak institutions and state failure can lead to negative consequences when linked with resource abundance. What is governance then? One important distinction is the difference between resource governance and resource management. The concept of resource management and the closely linked concept of integrated or sustainable resource management are precursors to the resource governance concept. According to C. Pahl-Wostl (2009):

“Resources management refers to the activities of analyzing and monitoring, developing and implementing measures to keep the state of a resource within desirable bounds. The notion of resource governance takes into account the different actors and networks that help formulate and implement environmental policy and/or policy instruments.”

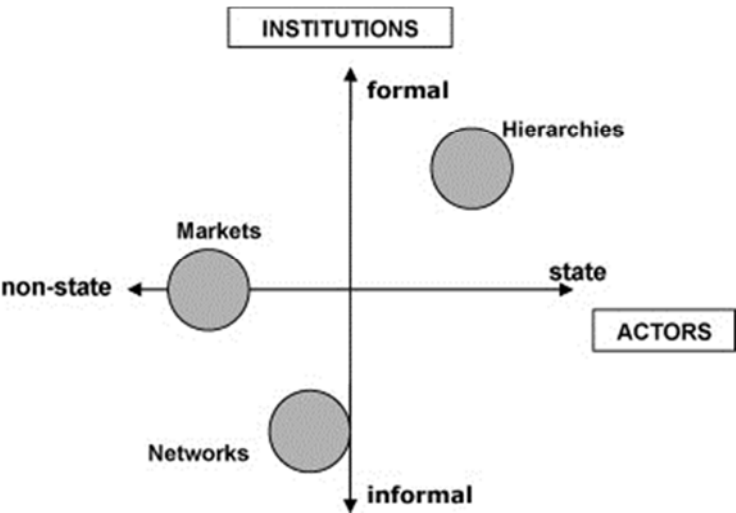


Figure 1 Difference of governance modes of bureaucratic hierarchies, markets, and networks regarding the degree of formality of institutions and the importance of state and non-state actors (Pahl-Wostl 2009)

We can see therefore that governance is more about the dynamics, interactions and power relations between stakeholders and resource users and less about the static measuring of resource use. Figure 1 illustrates different modes of governance within the context of actors and institutions. The evolution from management to governance analysis implies a change in thinking about policy processes towards a more fragmented framework where non-state and private actors carry as much influence as state actors in the formulation and implementation of public policy (Pahl-Wostl 2009). We find many strands of governance research in literature with each strand taking a different approach to conceptualizing governance. Treib et al. (2005) analyze the major streams and classify them according to their focus on politics, polity or policy and provide an excellent reference on governance. Pahl-Wostl (2009) analyzes the concept from different theoretical approaches and proposes a framework for the adaptive capacity and

learning in different governance regimes. Moreno-Pires and Fidélis (2012) also briefly touch upon governance literature in their analysis of sustainable governance and provide examples of the diversity of definitions and approaches to the concept. They conclude, however, that all the approaches share a focus on institutional analysis, that is, the “the study of how people collectively behave and construct institutions, how institutions function in practice, and why institutions persist over time” (Moreno-Pires and Fidélis 2012) and that this type of analysis is central to the concept. Hezri and Dovers (2006) provide a look at governance through the lens of ecological economics and focus on aspects of efficiency and democracy.

The World Bank has been trying to measure governance across countries for some time with its World Governance Indicators (WGI) project lead by Dr. Kaufmann. Kaufmann et al. (2011) define governance in their paper on the methodology of the WGI as: “the traditions and institutions by which authority in a country is exercised”. According to Corrigan (2014) this definition points to three factors: the capacity of the government to formulate and implement sound policies, the process by which governments are selected, monitored and replaced, and the respect of citizens and the state for the institutions that govern economic and social interactions among them. For a further discussion of these indicators and the governance components they try to measure see C. Corrigan (2014). Kaufmann et al. (2011) confirm the lack of consensus and of a universal definition but they go on to break down the three factors mentioned above into operational dimensions that they further develop into indicators.

Three main mechanisms by which resource abundance influences governance negatively have been identified in the literature (Pahl-Wostl 2009, Corrigan 2014, Kolstad and Soreide 2009, Kolstad and Wiig 2009) and reviewed by Busse and Gröning (2013) while providing examples of empirical studies on these mechanisms (however, they only focus on political outcomes of resource abundance and ignore other aspects that are analyzed, for example, by Frankel (2010)). First of all, so-called rentier effects have been identified by Ross (2001) in countries where natural resources provide considerable direct revenues to the state. These revenues can then create adverse effects in three forms: (1) reduce the need for taxation of the population and therefore reduce the call for accountability from the low-taxed population (taxation effect); (2) so-called patronage which is the use of resource revenues to mitigate dissent among the population and fortify one’s own political support and network (spending effect); and (3) spending resource funds to prevent the formation of special interest or social groups that would advocate more political rights (group formation effect) (Busse and Gröning 2013). The second main mechanism is a repression dynamic based on the assumption that governments can use resource revenues to “suppress demands for changes in the political system or the functioning of the government in general. With greater spending on national security, resource-rich governments could impede aspirations among the population for more democracy or better institutions and government services” (Busse and Gröning 2013). The third mechanism is linked to the resource industry sector itself and follows an assumption that resource rents might prevent the modernization of the sector and induce stagnation and a status quo. The

possibility of lower education investment is also mentioned which would then impact the demand for political reform. “To sum up, due to a variety of causal mechanisms the institutional setting and quality of governance may be lesser in resource-abundant countries in comparison to resource-poor countries.” (Busse and Gröning 2013)

One of the main effects of resource abundance, therefore, is increased corruption in the political sector which plagues the governance regime and lowers institutional quality. Kolstad and Soreide (2009) affirm boldly: “Corruption is the main reason why resource-rich countries perform badly in economic terms. This is an implication of current theories and evidence on the resource curse. This suggests that corruption is the development problem in resource-rich countries rather than just one of a number of problems.” In parallel, transparency has risen as corruption’s nemesis and the concept has gained much traction in recent years as the perfect weapon for combatting corruption and therefore improving governance in resource-rich countries. We will analyze these two interlinked concepts in the next section. Transparency has therefore been identified as a sort of proxy variable of good governance.

### 2.3 Transparency and corruption

“Secrecy serves to entrench incumbents, discourage public participation in democratic processes, and undermines the ability of the press to provide an effective check against the abuses of government.” (Stiglitz 1999) This quote illustrates the link between transparency and corruption and fits into the context of the research outlined above. Figure 2 provides an illustration of the correlation between political transparency and the control of corruption. As we can see there is a positive trend between higher transparency and higher control of corruption.

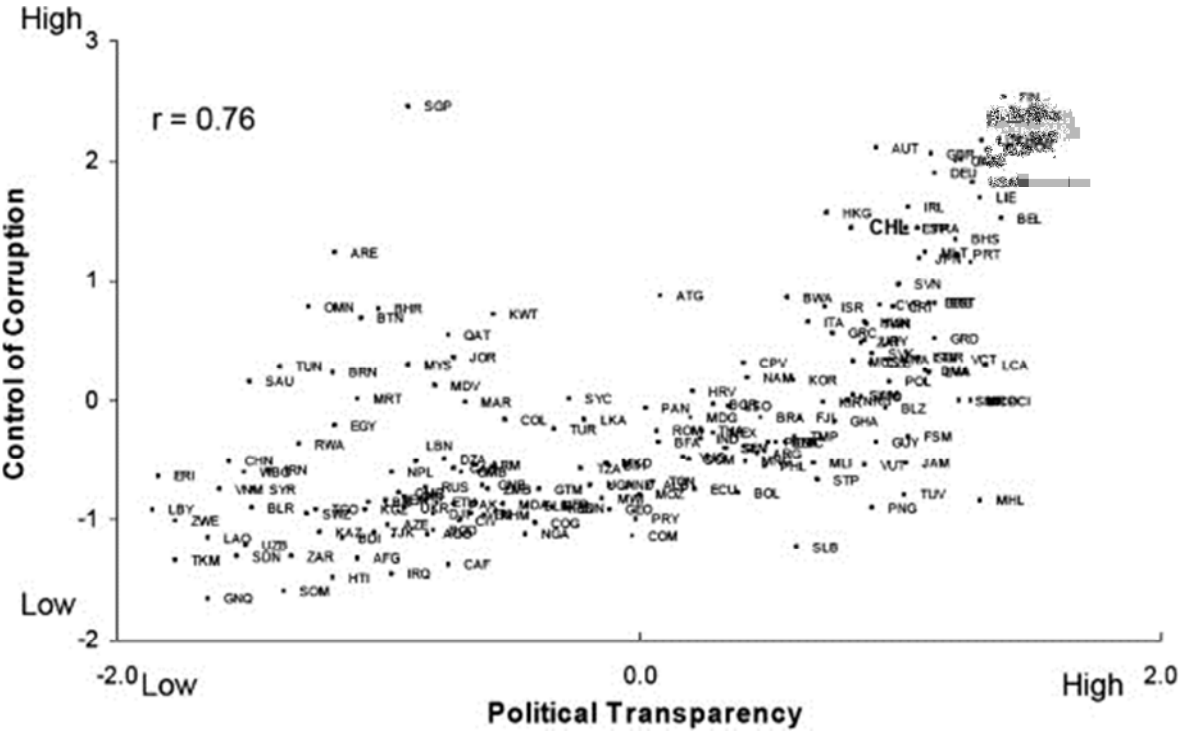


Figure 2 Political transparency and corruption (Kaufmann and Bellver 2005)

It is beyond the scope of this work to delve into all the details and nuances of the corruption concept so, while providing relevant literature and a brief overview, the focus will be rather on transparency and the different dimensions thereof all the while taking into account relevant links with corruption. For a detailed look at the linkages between corruption and transparency consult Kolstad and Wiig (2009). For a broader look at transparency within the context of environmental governance consult Gupta and Mason (2014).

This section will, however, explore questions of what exactly is transparency, what kind of impacts it can have in the context of resource governance and how it can be used in the most efficient manner to underpin good resource governance. So what does transparency consist of and how does it fit into the resource curse and resource governance agenda?

As stated by Kaufmann (2015) of the NRGi writing about and measuring corruption have become less of a taboo topic in recent years and researchers have started tackling the problem along with NGOs and governmental initiatives. Within this scope, transparency has surfaced as an almost universally accepted means to curbing corruption (Bleischwitz 2014, Mejia Acosta 2010, Haufler 2010, Kolstad and Wiig 2009, Michener 2015, Corrigan 2014, McHenry et al. 2015, Alstine 2014). “In addressing corruption – and more generally enhancing accountability and governance – in natural resources, one should not underestimate the importance of transparency.” (Kaufmann p15, 2015)

Transparency can be defined as the disclosure (providing public access to) of reliable economic, social and political information, that governments and/or corporations previously considered confidential, in a timely manner and making it accessible to all relevant stakeholders (Bleischwitz 2014, Kolstad and Wiig 2009). This concept and its supposed positive effects on curbing corruption and improving governance has spurred a proliferation of a number of transparency initiatives that try to implement transparency in governmental and corporate processes. While there are several such initiatives focusing on different domains, the Extractive Industries Transparency Initiative (EITI) and the Resource Governance Index (RGI) produced by the Natural Resource Governance Institute (NRGI) will be most discussed in this work.

Most of the literature above provides examples and discussions of some such initiatives but for a brief and salient overview consult Bleischwitz (2009) and for an extensive and in depth account of the historic development of transparency on the international level consult Haufler (2010). As pointed out by Mejia Acosta (2010), however, the idea of good natural resource governance presents some empirical challenges and different initiatives equate it with different outcomes. The underlying assumption for most advocates of transparency is that increased transparency of information opens up the decision making process to public debate, increases accountability of governments and corporations to the public, all the while improving legitimacy and providing incentives for more efficient financial management. After all “democracy itself is founded on the principle of transparent governance, and efficient markets depend on



full information” (Haufler p55, 2010). Kolstad and Wiig (2009) analyze these assumptions in detail through the different dimensions of transparency and corruption and their links using a principle-agent framework and looking at correlations through regression analysis. Haufler (2010) provides a more qualitative and socio-economic assessment of transparency development while developing a detailed theory of transparency as a concept and its diffusion as an international policy.

However, there is still a debate going on because most of the transparency initiatives and efforts are focusing more on processes rather than actual outcomes. In other words, “while most transparency and accountability initiatives are geared towards attaining an expected or desirable outcome such as improved economic performance or poverty reduction, most project interventions are in fact process-oriented (such as the adoption and validation of EITI status) but it is less clear what are the causal mechanisms that contribute to effective development outcomes” (Mejia Acosta 2010). The weak link in the transparency discourse is proving the causal relationship between transparency measures and actual positive outcomes and improved governance. It is often assumed that just creating a freedom of information law or adhering to a transparency standard will somehow magically transform decision making processes and improve the extractive industry. On the one hand it is too early to tell with certainty considering this is a relatively new development on the international scale and on the other hand this assumption does not do justice to the complexity of the issue. Figure 3 illustrates the assumption behind the EITI and most transparency initiatives that is oft criticized for being too simplistic.



Figure 3 The logic underpinning the EITI (source: Corrigan 2014)

The academic literature is not devoid of skeptics however and several authors have cast a critical look at the actual impacts and improvements of transparency measures (Haufler 2010, Mejia Acosta 2010, Bleischwitz 2009, Kolstad and Wiig 2009, Corrigan 2014, McHenry et al. 2015). What comes out of these works is that the link between transparency and better governance is not linear and as simple as it appears and the effects of transparency can be varied and not even always positive. Many factors come into play because, like everything, transparency does not exist in a bubble, governance is linked to many other factors that can influence it, and transparency of information has a relatively complex qualitative dimension. Too much information, faulty information, hard to understand information, late information, conflicting information can all hinder the expected outcomes and therefore it is important to look at what type of information is being disclosed and in what way is it being disclosed. Another issue worth

considering is the heterogeneous adoption of transparency measures; particularly in the private sector it is hard to convince companies to disclose their information if others are not doing it too because concerns of losing competitive advantages may dissuade companies to be early adopters.

A relatively exhaustive list (Haufler 2010) of the categories of information that can be disclosed includes: details of the call for proposals and bidding process for natural resources exploration and development contracts, the contents and terms of these contracts, payments made by companies to governments (royalties, taxes, signing bonuses, fees), pricing decisions, the size of reserves, the location of resources, exploration, and development, prior informed consent to communities affected by proposed developments, and government budgets for distributing resource rents.

In the words of Kolstad and Wiig (p524, 2009): “in addition to access to information, you need an ability to process the information, and the ability and incentives to act on the processed information”. This then implies an informed, well-educated and proactive population that can act on the disclosed information as well as a government with competent employees that are willing to commit to change. Kolstad and Wiig go on to conclude that transparency by itself is not enough to have a significant impact, particularly in countries with high levels of corruption and weak institutions. Therefore, several enabling factors need to be present in order for transparency to reach its potential. One of the most important recommendations to come out of the literature is that transparency initiatives should shift from their focus on resource revenues towards a focus on expenditures because it is the expenditures that would show whether resource wealth is distributed equitably and efficiently. Finally, a critique is pointed at the EITI initiative in that it is too narrow in its scope: “it does not address upstream activities, such as procurement, which constitute a significant part of the value chain in oil and gas, nor does it cover the distribution of income and public expenditure stemming from the extractive industry revenues” (Kolstad and Wiig p527, 2009). Figure 4 illustrates this narrow scope.

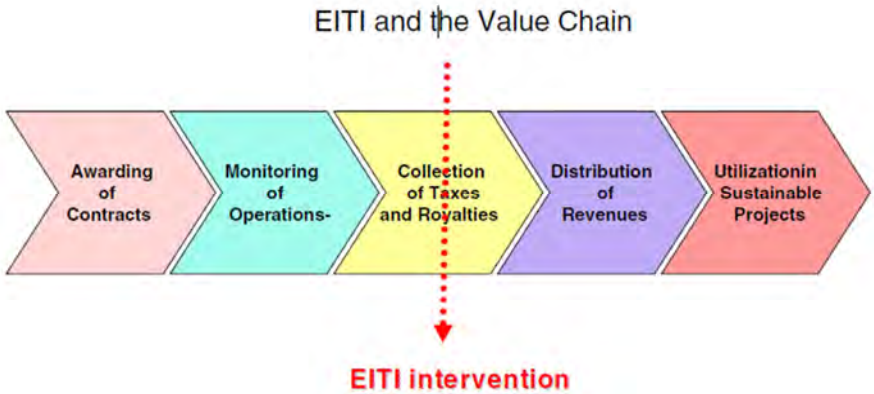


Figure 4 The scope of the EITI (Kolstad and Wiig 2009)

Mchenry et al. (2015) differentiate between disclosure and true transparency, advocate a “simulated user” approach and criticize initiatives like the EITI for lacking consistent data, not including environmental considerations, and having limited effectiveness. They put forward a best practice case

study of an environmental mining securities policy in Western Australia as a near-ideal tool for resolving these problems and creating tangible positive results through transparency and accountability. Even though transparency has become ubiquitous in public and private administration and in resource curse literature it is, nevertheless, a multi-dimensional concept that has multiple layers of meaning, it is politically burdensome and tricky to operationalize.

## 2.4 Indexes and measuring performance

There are many different approaches to measuring the performance of the extractive industry and the effects of natural resource extraction on the human and natural environment. Considering the cross-cutting and multidimensional nature of the subject this is not surprising. Research from the Integrated natural resource management (INRM) school of thought advocates holistic and integrated approaches that look at all the dimensions of the problem (Lovell et al. 2002, Campbell et al. 2001) and the factors influencing it. The complexity of this field of study is highlighted as a defining factor (Ostendorf 2011) which warrants careful framing and analysis of the ins and outs before determining the approach. This complexity arises from:

- Multiple scales of interaction and response;
- The high frequency of nonlinearities, uncertainty, and time lags in complex systems;
- Multiple stakeholders with often contrasting objectives that complicate the task of identifying research and management aims and finding trade-offs among them;
- The context specificity of INRM sites; and
- The problem of maintaining integration in the face of numerous components and interactions. (Campbell et al. 2001)

The question of scale is put forward as central when considering natural resource management; Lovell et al. (2002) dedicate their work to resolving the issue of differing temporal, institutional, and bio-physical scales. Campbell et al. (2001) also highlight the issue of multiple relevant scales and they propose the sustainable livelihoods approach as a conceptual framework capable of integrating the multiple dimensions and scales of resource management. Within the context of multiple scales the use of GIS tools is helpful and even “self-evident” according to the authors.

Other approaches focus more on the environmental side of the issue and advocate using known methods and frameworks in the context of the extractive industry. The ecosystem services approach (Hinojosa and Hennerman 2012) and the ecological footprint (Swiss Academies of Arts and Sciences 2012) are two well-known methods for quantifying resource use and can therefore be applied to the extractive sector in order to measure its impact. Life cycle assessments are another way of quantifying natural resource and its impacts (ibid.). Finally, some authors advocate the use of system modelling (Campbell et al. 2001, Ostendorf 2011) techniques to bypass problems of lacking data and temporal scales

because it allows for the comparison of model results with real life data and the study of possible future outcomes.

Finally, the improvement and development of GIS methods, parallel to the international growth of the extractive industry, has increased its use in this context as well (Bebbington et al. 2014). Participatory GIS is a relatively novel branch that has garnered some attention and has been applied to the extractive industry domain as a way of fostering local community participation, including local knowledge and perspectives while providing a cost-effective solution to problems of lacking data (Norris 2014). A 2011 (volume 11) special issue of the *Ecological Indicators* journal provides some examples of using spatial information in a natural resource management context. However, the focus is on renewable resources like forests and fisheries and on the natural side of impacts. A more recent special issue of the *Applied Geography* journal (2014, volume 54) includes several articles that apply GIS methods to different facets of the extractive industry in an effort to improve its outcomes. These studies (Emel et al. 2014, Cuba et al. 2014, Aistrup et al. 2013, Hinojosa and Hennerman 2012) show the potential of visual information in bringing forth links, interactions, and dynamics that are hard to see otherwise.

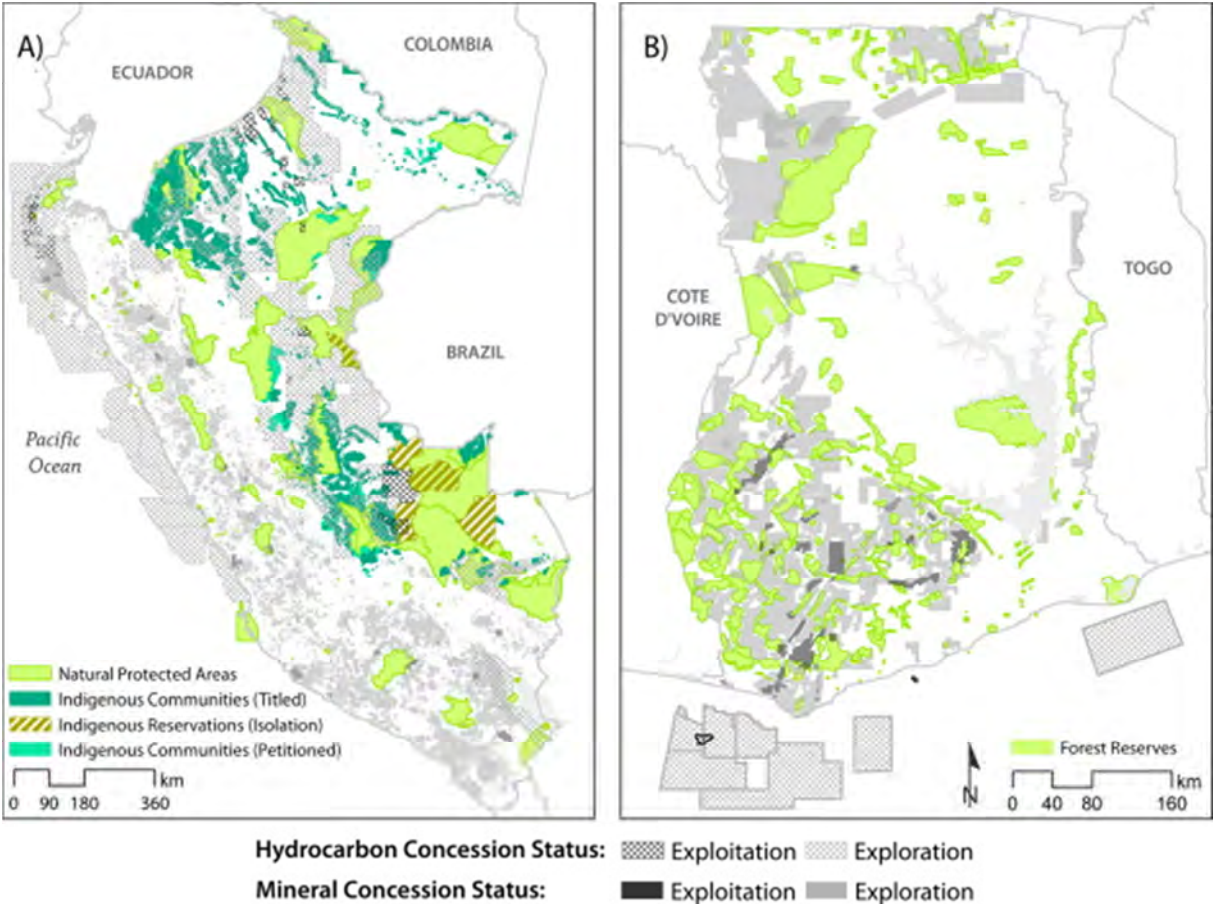


Figure 5 Overlap of mining concessions and protected land use types in Peru (A) and Ghana (B) (Cuba et al. 2014)

The focus of this work is on a particular method of measuring resource governance that is the composite or aggregate index. Indexes are the sort of empirical and quantitative arm of the transparency and governance branch of extractive industry analysis. While initiatives such as the EITI and the Publish

What You Pay campaign set standards and work on a case by case basis, indexes try to quantify concepts such as transparency and governance and give aggregate numerical scores based on this quantification on a global level. There are so-called concept indexes, which measure a single multi-dimensional concept, and policy indexes, which measure policies in a certain sector; policy indexes have received much less attention in academic literature than the concept indexes (Michener 2015). While there is a multitude of concept indexes, one of the most well-known sets of indicators to measure governance on a global level are the World Bank's Worldwide Governance Indicators (WGI). In the case of transparency the Global Open Data Index is well-known and creates scores based only on the transparency of data governments provide and the World Justice Project's Open Government Index is another example of scoring government transparency with a slightly broader scope. The RGI is a policy index and it focuses on the policy domain of governance of natural resources in resource rich countries. Much of it is composed of measures of transparency which follows as a logical link based on the literature review above but a detailed breakdown of its methodology will follow in the next section.

Bleischwitz (2009), echoing the INRM research, argues that transparency is just one avenue towards better resource governance and that additional measures need to be included to measure governance in all its dimensions. In particular, environmental indicators could add validity, measure real effects of extractive operations and not only financial ones, and promote better environmental governance and accountability. "A driving force to include key environmental indicators could be the vision of increasing revenues and public investments for green economies in resource-rich developing countries, with global prosperity stemming from increasing resource efficiency and lowering environmental risks along international value chains." (Bleischwitz p7, 2009) This argument is sound and the RGI could benefit from integrating environmental indicators or be used in conjunction with such already existing measures. However, the development of such a mega index is beyond the scope of this work and indeed beyond the resources of the NRGI. I argue that as a starting point the RGI should make use of GIS technology and methodology to include a spatial component that would facilitate interpretation of the numerical scores and add validity all the while expanding the scope of the index by looking at concrete, spatial manifestations of its governance and transparency scores.

Slack (2014), Bebbington et al. (2014), and McHenry et al. (2015) advocate the added value that mapping and visualizing can bring to the analysis of resource governance. Campbell (p11, 2001) highlights the logic behind this approach: "The problem of defining indicators for systems performance must be addressed at two (or more) levels: a broad level of indicators that help to evaluate the effectiveness of management generally; and, a narrower, more context-specific set of indicators that relate to the particular sociopolitical, economic, and ecological conditions of a defined system". The RGI currently satisfies the first level of analysis but lacks the second level. A spatial component developed with the GIS toolbox could provide the second level.