



Beyond Revenues: Measuring and Valuing Environmental and Social Impacts in Extractive Sector Governance

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Contents

EXECUTIVE SUMMARY	4
I. HOW EFFECTIVELY ARE HOST COUNTRIES MEASURING AND VALUING ENVIRONMENTAL AND SOCIAL IMPACTS IN EXTRACTIVE SECTOR GOVERNANCE?	7
II. ABOUT THIS REPORT	10
III. WHAT DO WE MEAN BY MEASURING?	13
IV. PRIVATE SECTOR APPROACHES TO MEASURING AND REPORTING ENVIRONMENTAL AND SOCIAL IMPACTS.....	15
V. GOVERNMENT APPROACHES TO MEASURING ENVIRONMENTAL AND SOCIAL IMPACTS IN THE EXTRACTIVE SECTOR	19
VI. MODELING AND MEASURING ENVIRONMENTAL AND SOCIAL IMPACTS IN EXTRACTIVE SECTOR DECISION-MAKING	25
VII. THE TOOL EXPLORER	31
VIII. GUIDING PRINCIPLES FOR MEASURING ENVIRONMENTAL AND SOCIAL IMPACTS	37
CONCLUSION.....	43

Key messages

- Host countries must weigh the economic benefits of extractive projects against their environmental and social impacts.
- However, environmental and social impacts are often assessed in separate processes and by separate institutions from those assessing financial revenues and the modeling, measuring and reporting of these impacts is rarely integrated with financial impacts.
- This practice results in an incomplete picture of the extractive sector. A more integrated assessment of the impacts of extraction could help policymakers, regulators, companies, citizens and affected communities make more informed decisions on whether extraction should take place and on what terms and conditions.
- Extractive sector stakeholders can use this report and the accompanying Tool Explorer—a database of tools, frameworks and standards for measuring and valuing environmental and social impacts—to better integrate modeling, measurement and reporting of revenues and environmental and social impacts to enhance governance and management of extractive sectors for the public good.
- Measurement and valuation of environmental and social impacts pose a number of risks, not least reinforcement or exacerbation of power imbalances. This report outlines general principles that might help support inclusive, transparent, multi-stakeholder processes.

Executive summary

Oil, gas and mineral projects have the potential to provide their host countries with substantial fiscal revenues. Thanks to widely accepted standards for financial accounting, governments, extractive companies and oversight actors can model, measure, disclose and audit these fiscal revenues.

The same is not true for the environmental and social impacts of the extractives sector. Although there is no shortage of actors engaged in modeling, measuring and monitoring the non-fiscal impacts of extraction, environmental and social impacts are rarely integrated with financial modeling of the expected fiscal benefits of a project.

This disconnect leads to an incomplete understanding of the economic contribution of extractive projects, making it difficult for policymakers, regulators, investors, citizens and impacted communities to understand how environmental and social impacts compare with resource revenues—and to design regulations that effectively balance fiscal returns with environmental and social stewardship.

To better understand whether more integrated modeling and measurement of environmental and social impacts can improve policymaking in the extractive sector, we undertook a review of existing practices in measuring environmental and social impacts in the extractive sector of NREGI's priority countries, including tools available for doing so.

Based on a review of the extant literature and data from stakeholder questionnaires, we identified fifty-eight tools, frameworks and standards that are designed for, or may be adapted to, measuring environmental and social impacts in the extractive sector.

More of these tools are designed to measure environmental impacts than social impacts. Forty-five percent are designed to measure general environmental impacts, nine percent biodiversity, nine percent water consumption or pollution and three percent air, climate or greenhouse gas emissions, while 14 percent are designed to measure general social impacts. Twenty-one percent are designed to measure all material impacts or “total impacts.”

In addition, most of the tools that assign a monetary value to impacts focus on general environmental impacts as opposed to general social impacts.

Only eight percent of the tools are gender-sensitive, meaning that they include a way for gender impacts and considerations to be taken into account in the measurement process.

Box 1. About the tools, frameworks and standards in the database

- Most use quantitative (95 percent) methods to measure impacts; a number also assign a monetary value to impacts (31 percent).
- Most (86 percent) take natural capital into account, followed by social capital (50 percent), human capital (40 percent), financial capital (33 percent) and built capital (31 percent).
- The majority measure impacts at the project/site (95 percent), company/enterprise (88 percent), or multiple levels of analysis (93 percent); 66 percent assess impacts at the sector/industry level.

General awareness of tools, frameworks and standards for the modeling and measurement of environmental and social impacts in the extractive sector was relatively low across questionnaire respondents. Respondents felt that it is equally important to measure the impacts of extractive projects across the different forms of capital; yet they believed that measuring social capital, political capital, cultural capital and to an extent natural capital, is more difficult than measuring financial and built capital.

Although government legislation tends to provide for environmental and social impact assessments (ESIAs) in the approval process for extractive projects, it typically leaves the exact tools and methods used to quantify these impacts to the discretion of extractive companies and their consultants. This results in varying standards for measuring and quantitative reporting, and limits comparability of environmental and social impact management across projects.

With this report and the accompanying database of tools, frameworks and standards, we seek to support a conversation on:

- 1 Whether existing tools can adequately measure the environmental and social impacts of extraction.
- 2 Whether the modeling of environmental and social impacts can be integrated with fiscal modeling to inform governments, companies and stakeholders in making the decision to extract or not.
- 3 How extractive sector stakeholders can more effectively integrate the measurement of environmental and social impacts into the regulation and management of the sector to maximize benefits and minimize costs.
- 4 Whether country-level or global-level processes and standards for measuring, valuing and reporting the environmental and social impacts generated by extractive projects can facilitate comparability and better understanding of how well these impacts are being managed.

There are several areas where measurement of the environmental and social impacts of extraction might enhance policymaking or regulation, including:

- The decision to open an area for extraction
- Compensation schemes for affected communities
- Design of community development programs
- Revenue transfers from central government to resource-producing areas
- Design of regulations to promote a positive impact (local content regulations) or reduce a negative impact (environmental regulations) of extraction

However, measurement can only support better policymaking if all stakeholders consider the process valid and fair. We propose the following general principles for using measurement of environmental and social impacts in decision-making within the extractive sector. When used alongside qualitative approaches, these principles could help support an inclusive and transparent measurement process that promotes multi-stakeholder dialogue on extractive sector impacts.

Guiding principles for measuring environmental and social impacts

Who	<p>Principle 1. Ensure inclusive multi-stakeholder measurement processes that enable meaningful participation of affected communities, with due regard for gender dynamics and the views of minority and marginalized groups.</p> <p>Principle 2. Involve interdisciplinary teams from the start.</p>
When	<p>Principle 3. Begin measurement of environmental and social impacts before extraction and continue through the life of the project and after closure.</p>
What	<p>Principle 4. Identify material impacts across capitals (built, financial, human, natural or social capital), project scenarios, geographic scales and time horizons.</p> <p>Principle 5. Include in stakeholder dialogue and decision-making frameworks both quantifiable impacts and those that cannot or should not be measured; and consider who bears the costs and benefits of these impacts.</p>
How	<p>Principle 7. Ensure measurement approaches are appropriate to the policy question at hand and to the country and local context.</p> <p>Principle 8. Protect legal and customary rights throughout the measurement process, including free, prior and informed consent where applicable.</p> <p>Principle 9. Ensure measurement processes and results are transparent, timely and understandable.</p>

I. How effectively are host countries measuring and valuing environmental and social impacts in extractive sector governance?

Extractive projects can generate substantial revenues for host countries.¹ At the same time, extractive activities generate a range of other positive and negative economic, environmental, social, political, institutional and cultural impacts. These costs and benefits play out over different levels of analysis,² at different scales,³ across different capitals,⁴ and over multiple time horizons.⁵

Financial modeling of an extractive project's potential revenues is now a well-established practice that informs the economic decisions of companies and governments alike. Indicators such as government take, average effective tax rate and company internal rate of return provide valuable information on the potential financial value and viability of extractive projects. The availability of open financial modeling tools has also empowered a range of oversight actors, including citizens, to model the expected fiscal benefits of a project and more effectively participate in public debates on whether an extractive project is a "good deal" for the country.⁶ These debates often focus on (1) the revenues that will be generated from the extraction and sale of the resource, (2) the extent to which government and non-government groups may share in these revenues through royalties, taxes and fees and (3) how these revenues will be spent, saved or distributed. The Extractives Industries Transparency Initiative (EITI) and laws requiring company disclosure of extractive payments to governments have also provided a wealth of information on payments made to national and subnational government entities as well as beneficiaries such as landowners and community groups, allowing for ongoing public scrutiny of an extractive project's financial benefits.⁷

Yet when considering the economic impact of extractive projects, governments and non-governmental actors that are focused on revenue maximization and revenue transparency can inadvertently under-measure, undervalue and underestimate environmental and social impacts.

When considering the economic impact of extractive projects, governments and non-governmental actors that are focused on revenues can under-measure, undervalue and underestimate environmental and social impacts.

1 See, for example, the International Council for Mining and Metal's (ICMM) Mining Contribution Index (www.icmm.com/en-gb/society-and-the-economy/role-of-mining-in-national-economies/mining-contribution-index).

2 For example, project-level, subnational, national, regional and global.

3 For example, impacts might differ in the extent of their geological footprint, or the percentage of the population that is affected.

4 For instance, built, financial, human, natural or social capital.

5 For instance, intergenerational impacts, or impacts that manifest over the short, medium or long term.

6 The International Monetary Fund's (IMF) Fiscal Analysis of Resource Industries (FARI) is one such financial model. Several non-governmental organizations or academic institutions, such as NRGI (resourcegovernance.org/economic-models), Open Oil (openoil.net/contract-modeling), Columbia University's Center on Sustainable Investment (CCSI) (ccsi.columbia.edu/work/projects/open-fiscal-models), have also created open financial models for public use.

7 Examples of payment disclosure laws include the amendments to the European Union (EU) Accounting and Transparency Directives of 2013, regulations adopted in late 2013 in Norway pursuant to the Accounting Act and Securities Trading Act, the U.K.'s Reports on Payments to Governments Regulations 2014 implementing the EU Accounting Directive and Canada's Extractive Sector Transparency Measures Act of 2014.

There are, of course, a range of actors engaged in modeling, measuring, assessing and monitoring the environmental and social impacts of extraction, including civil society organizations and research institutions.^{8,9} These actors often seek to draw attention to the impacts of extractive projects on communities or to mobilize and campaign against company failures and abuses, government mismanagement, or at times extraction altogether. For their part, host governments commonly use strategic impact assessments or environmental and social impact assessments to understand the actual and potential environmental and social impacts of extraction,¹⁰ while companies have developed various tools, frameworks and standards to model, measure and communicate the environmental and social impacts of their activities.¹¹

However, government approaches to assessing and monitoring the environmental and social impacts of extraction are typically disconnected from the modeling, measuring and reporting of financial flows. If they factor into governments' or oversight actors' analysis of the *economic* impact of a project, it is typically through a risk management lens (for example, mitigation or control measures to eliminate or reduce negative impacts), or at times a "value-capture" lens (for example, local content policies to maximize in-country capture of employment or supply chain opportunities). It is rare for environmental and social impacts to be integrated into financial models to assess how these impacts might affect the expected economic contribution of the project.

Further, compared with revenue reporting, global standards are lacking for multi-stakeholder reporting of the environmental and social impacts of extraction in quantitative terms, and especially monetary terms.¹²

The result is that countries and markets may be failing to adequately account for, monitor and regulate the negative impacts or externalities of extraction. One study of gold mining in Ghana, for example, emphasized that losses in agricultural productivity from air pollution caused by mining in a particular year were larger than the fiscal revenues that gold projects generated for the state in that year.¹³ At the same time, countries may also miss opportunities to maximize benefits. One study of the local economic impact of a large gold mine in Peru demonstrated that a local procurement policy resulted in a positive effect on household's real income.¹⁴

Failure to adequately assess how the costs and benefits of extraction are distributed across the country might also lead to suboptimal decisions. Heavy costs borne by local communities can lead to political opposition and conflict that determine whether

One study of gold mining in Ghana emphasized that losses in agricultural productivity from air pollution caused by mining in a particular year were larger than the fiscal revenues that gold projects generated for the state in that year.

8 For example, The Nature Conservancy, Oxfam and the NGO Mining Working Group.

9 For example, The University of Queensland's Sustainable Minerals Institute, Colorado School of Mines and Exeter University's Camborne School of Mines.

10 See Section V.

11 See Section IV.

12 However, transparency good practice standards like the natural resource pillar (Pillar IV) of the IMF's new Fiscal Transparency Code include publication of environmental and social impact assessments, as well as their associated management plans and reports, along with identification of "fiscal risks associated with operational, social and environmental aspects of major projects." International Monetary Fund, *Fiscal Transparency Code, Resource Revenue Management (Pillar IV)* (2019), www.imf.org/en/Publications/Policy-Papers/Issues/2019/01/29/pp122818fiscal-transparency-initiative-integration-of-natural-resource-management-issues.

13 Fernando M. Aragon and Juan Pablo Rud, "Polluting Industries and Agricultural Productivity: Evidence from Mining in Ghana," *The Economic Journal* (2015): 1980 – 2011.

14 The study of the local economic impact of Yanacocha, a large gold mine in Northern Peru, demonstrated a positive effect of the mine's demand for local inputs on real income in the supply market and surrounding areas, reaching unskilled workers in non-mining sectors. The demand for local inputs was driven by an explicit corporate policy aimed at increasing participation of local firms. The positive impact seemed to come via market channels rather than revenue windfalls to local governments. Aragón, Fernando M., and Juan Pablo Rud, "Natural Resources and Local Communities: Evidence from a Peruvian Gold Mine." *American Economic Journal: Economic Policy*, 5 (2) (2013): 1-25.

extraction will continue, regardless of potential benefits.¹⁵ On the other hand, a lack of political pressure and conflict can lead to a focus on national revenues while significant costs for communities are overlooked.¹⁶ In both kinds of cases, improved regulatory requirements could help to redistribute costs and benefits, address inequities and improve decision-making.¹⁷

Different approaches exist to assessing and improving the management of environmental and social impacts, including human rights advocacy and investigative journalistic approaches that look at the impacts in qualitative and descriptive terms. Measurement is only one approach that may complement, not replace, other approaches.

Nonetheless, more effective and integrated modeling, measurement and valuation of the environmental and social impacts of extraction can support a more holistic understanding of the costs and benefits of extraction for a country. It could also assist in more targeted and strategic design of environmental regulation and local content policies, help decision-makers balance the economic trade-offs involved in policy decisions and support regulators in their efforts to monitor impacts and manage company compliance with regulatory benchmarks or limits.

15 For example, mining bans have been issued in El Salvador (Gene Palumbo and Elisabeth Malkin, "El Salvador, Prizing Water Over Gold, Bans All Metal Mining," *New York Times*, 29 March 2017, www.nytimes.com/2017/03/29/world/americas/el-salvador-prizing-water-over-gold-bans-all-metal-mining.html) and Cajamarca province in Colombia ("Colombia municipality, home of AngloGold project, votes to ban mining," Reuters, 27 March 2017, www.reuters.com/article/colombia-mining-idUSL2N1H40Q8).

16 See, example, Aragon and Rud, "Polluting Industries and Agricultural Productivity."

17 For example, more effective environmental regulations, or local content or community development requirements, which might increase the costs of extraction and lower government revenues from particular extractive projects while still providing a net overall benefit through gains or reduced losses in other parts of the economy.

II. About this report

In order to better understand if and how environmental and social impacts can be better measured, we undertook a review of existing practice in measuring environmental and social impacts in the extractive sector of NRGIs' priority countries, including tools, frameworks and standards available for doing so.¹⁸

As used in this report, a “method” is a general technique for assessing environmental and social impacts, with prescribed principles, approaches or processes for data collection, analysis and reporting. Examples include ecosystem service valuation, ecological footprinting, life cycle assessment and input-output models.¹⁹

A “tool,” by comparison, is a specific assessment instrument that typically operationalizes a general method and is sometimes subject to proprietary rights. Examples include the Integrated Biodiversity Assessment Tool (IBAT), the Local Ecological Footprinting Tool (LEFT), the IFC's Financial Valuation Tool and PwC's Total Impact Measurement Management (TIMM).²⁰

A “framework” is an initiative that promotes certain processes, methods or tools to measure or value environmental or social impacts. Examples include the Natural Capital Protocol and the Measuring Impact Framework.

A “standard” seeks to standardize the measurement or reporting of environmental and social impacts.

Throughout this report, we simply use “tools” to collectively refer to the tools, frameworks and standards included in the database.

To find existing tools, first, we conducted a series of search-engine searches to identify research articles and reports containing descriptions of tools and methods for measuring or valuing environmental and social impacts across capitals. The purpose of these searches was to gather descriptive data on the usage of tools and methods in the academic and applied literature.

We also used a questionnaire to identify stakeholders who are working on tools and methods to measure environmental and social impacts in the extractive sector. A total of 27 people completed the questionnaire, representing extractive companies, multilateral or donor organizations, consulting companies, governments or regulators, academic or training institutions, non-governmental organizations or other types of entities.

Finally, we conducted desktop reviews on publicly available information on environmental and social impact measurement in NRGIs' priority countries. The reviews involved consultations with NRGIs' regional and country teams, sourcing of information from government websites and web searches targeted at the regulatory regime in the extractive sector, as well as the current practice measuring and valuing environmental and social impacts.

Our research shows that various actors have developed a range of tools for measuring or valuing environmental and social impacts, some of which have been designed specifically for the extractive industry. The tools vary in complexity and data

18 NRGIs' prioritizes a set of resource-rich countries for its work: The Democratic Republic of Congo, Guinea, Nigeria, and Tanzania in Africa; Indonesia and Myanmar in Asia; Mongolia in Eurasia; Colombia and Mexico in Latin America; and Tunisia in Middle East and North Africa. See resourcegovernance.org/countries.

19 See Section VII for more details on methods.

20 See accompanying Tools Explorer for more details on these tools.

requirements. Some require experts or support from the developer of the tool for their use, while others can be used independently by non-experts. Some tool developers provide training (free of charge or for a fee) for use of their tools. Different kinds of entities have developed the tools for different purposes and vary in the kind of user for which they were designed. Some tools were designed to assist companies in their decision-making, sustainability reporting or risk management. Other tools can assist policy-makers or civil society in measuring and tracking impacts over time, which can in turn assist with monitoring compliance, while others model potential impacts and translate quantities into monetary terms and may therefore be more easily incorporated into financial models.

We have collated information on various tools, frameworks and standards into a database that allows users to search for tools based on their interest or needs, including the sector they are studying (whether oil and gas or mining), the type of impact they would like to measure and whether they are interested in modeling potential impacts or measuring actual impacts.

With this report and the accompanying database of tools, frameworks and standards, we seek to support a conversation on:

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- 3 How extractive sector stakeholders can more effectively integrate the measurement of environmental and social impacts into the regulation and management of the sector to maximize benefits and minimize costs.
- 4 Whether country-level or global-level processes and standards for measuring, valuing and reporting the environmental and social impacts generated by extractive projects can facilitate comparability and better understanding of how well these impacts are being managed.

This report and accompanying database of tools would be of interest to:

- 1 Governments seeking to use measurement to support their policymaking and regulation of the sector.
- 2 Civil society actors who want to broaden their monitoring of environmental and social impacts of extraction or their analysis of the economic impact of extractive projects.
- 3 Companies seeking to demonstrate their positive contributions to the economy beyond fiscal payments, as well as their management of negative environmental and social impacts or compliance with existing laws and regulations.
- 4 Experts and academics in this field, who may find the database a useful clearinghouse for several tools, frameworks and standards developed by their peers.

Section III of this report defines measurement and valuation for the purposes of this report, including some cautionary notes on measurement and valuation. Section IV describes private sector-led initiatives on measuring and reporting on environmental and social impacts, including voluntary standards and codes and standardization initiatives. Section V looks at advances in government approaches to measuring environmental and social impacts within the national economy, compared with

approaches to measuring these impacts in the extractive sector. Section VI offers examples of how different actors in the extractive sector have used or could use measurement in decision-making. Section VII presents the tools database, or Tool Explorer. Section VIII presents suggested guiding principles for using measurement in decision-making within the extractive sector.

III. What do we mean by measuring?

Measurement, or quantification, is a technique used to determine the magnitude of impacts in units.²¹ For example, an organization can track individual metrics such as tons of carbon dioxide equivalent (CO₂e) emitted or how many jobs have been created. Measurement is not always difficult but can often be time-consuming. Measurement can consist of quantifying impacts of an extractive project that have already occurred or estimating the magnitude of impacts that could potentially occur in the future, using modeling.

Modeling is a technique used to predict the occurrence and magnitude of impacts, drawing on existing data and relying on various assumptions. It typically takes place in the pre-feasibility and feasibility stages of extractive projects and may be used to predict the magnitude of economic, environmental or social impacts of extractive projects under various scenarios.

Valuation, on the other hand, includes the additional step of assigning a monetary value to the magnitude of that particular impact. Monetizing environmental and social impacts can be relatively simple or staggeringly complex and can be controversial. For example, translating a weight of toxic effluent into a financial value is relatively easy if the market or regulators have put a price on it. However, whether it is appropriate to adopt the market price is another question altogether. Moreover, the financial implications of compromising a wildlife habitat, or incurring a loss of cultural heritage, may be more difficult to grasp. While valuation may bring attention to the scope of environmental and social impacts, and avoid the alternative scenario of “zero valuation,” it may reinforce power imbalances by allowing those already in positions of power—those with the necessary expertise, political influence and economic or other resources—to “price” nature or social impacts at the expense of other social groups who place non-monetary values on non-financial capitals.²² Pricing methods may also be imprecise or flawed, lead to systematic underestimation of non-financial value and undermine efforts to promote environmental protection and social safeguards.²³

Different kinds of entities (for example, private companies or academic institutions) developed existing tools, frameworks and standards for measuring environmental and social impacts for different audiences and for different purposes. As such, they may embody particular interests or biases.

It is important to bear all these drawbacks in mind when considering implementation of measurement and, in particular, valuation in assessment and management of environmental and social impacts. Measurement can provide a fuller but not complete appreciation of the extent of environmental and social impacts, along with other methods of assessment, including qualitative methods. Further, not all impacts can or should be measured.²⁴ Section VIII offers some suggested guiding principles for measurement.

Measurement can provide a fuller but not complete appreciation of the extent of environmental and social impacts, along with other methods of assessment, including qualitative methods.

21 For the purposes of this report, we use “measurement” and “quantification” interchangeably.

22 See, for example, the arguments put forward by Matthew A. Wilson and Richard B. Howarth, “Discourse-based valuation of ecosystem services: establishing fair outcomes through group deliberation,” *Ecological Economics* 41, no. 3 (2002): 431-443.

23 R. White, “Towards a green economy: the market,” in *Ecopolitics V: proceedings*, ed. Ronnie Harding. Sydney, Australia: University of New South Wales.

24 For example, it may be inappropriate to assign a quantitative measurement to impacts to culture heritage or sacred sites.

It is also important to note that environmental and social impacts of extraction often cumulate and manifest at different levels of analysis.²⁵ Cumulative impacts are the successive, incremental and combined impacts (both positive and negative) of an activity on society, the economy and the environment.²⁶ Cumulative impacts arise when:

- Impacts at different levels of analysis interact, for instance at the project, local, national, regional or global level.
- Activities of an extractive project interact with other extractive projects in a region.
- Activities of a single or multiple extractive projects interact or will interact with other past, current and future activities that may not be related to extraction.

In other words, there are temporal and spatial elements of cumulative impacts. They often manifest in intermediary or long-term impacts, such as food security, or impacts that are beyond the life of the project, such as land degradation or impacts to riverine systems. Cumulative impacts also manifest beyond the project area, or country in which the project is located. For instance, project-induced inequality or transboundary migration or conflict. At times, the cumulative impacts of extractive projects produce irreversible impacts to landscapes and their inhabitants.

25 British Columbia, Canada, has developed a cumulative effects framework to guide integration of cumulative effects considerations into natural resource decision-making processes and ensure cumulative effects are "identified, considered and managed consistently." British Columbia, *Cumulative Effects Framework*, accessed December 4, 2018, www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/cumulative-effects-framework.

26 See Daniel M. Franks, David Brereton and Chris J. Moran, "Managing the cumulative impacts of coal mining on regional communities and environments in Australia," *Impact Assessment and Project Appraisal* 28, no. 4 (2010): 299-312 and Daniel M. Franks, David Brereton and Chris J. Moran, "The cumulative dimensions of impact in resource regions," *Resources Policy* 38, no. 4 (2013): 640-647.

IV. Private sector approaches to measuring and reporting environmental and social impacts

The potential economic benefits of extractive projects must be weighed against their environmental and social impacts. The business model of extractive companies can be transformatively disruptive to communities and the natural environment. Examples of environmental degradation, human rights abuses, industrial relations issues, cultural heritage loss, social conflict and general discontent over the distribution of benefits, have become widespread in the extractive sector.^{27,28,29,30,31,32} Over the last few decades, these environmental and social impacts have become a flashpoint issue for regulators, communities and extractive companies alike.

In response to these sector-wide environmental and social performance challenges—or what some have labelled a “broken business model”³³—the extractive industry has embarked on a significant program to improve the image of the sector.³⁴ The private sector has made steps forward in promoting performance standards and frameworks for managing environmental and social impacts and has led initiatives to standardize sustainability accounting, measurement and reporting.

VOLUNTARY STANDARDS, CODES AND INVESTOR REPORTING FRAMEWORKS

In addition to the mandatory regulations—such as requirements to conduct environmental and social impact assessments (ESIAs)—that apply to the extractive sector in each operating jurisdiction, extractive companies adhere to a range of voluntary performance standards, frameworks and codes that impact the way in which they measure, manage and report on the environmental and social impacts of their operations.

Examples of environmental degradation, human rights abuses, industrial relations issues, cultural heritage loss, social conflict and general discontent over the distribution of benefits, have become widespread in the extractive sector.

- 27 R.E.W. Smith, M. Ahsanullah and G.E. Batley, “Investigations of the impact of effluent from the Ok Tedi copper mine on the fisheries resource in the Fly River, Papua New Guinea,” *Environmental Monitoring and Assessment* 14, no. 2-3 (1990): 315-331.
- 28 Chris Albin-Lackey. *Gold’s costly dividend: human rights impacts of Papua New Guinea’s Porgera gold mine* (Human Rights Watch, 2011).
- 29 Leanne A. Farrell, Ralph Hamann and Eric Mackres, “A clash of cultures (and lawyers): Anglo Platinum and mine-affected communities in Limpopo Province, South Africa,” *Resources Policy* 37, no. 2 (June 2012): 194-204.
- 30 Fenda A. Akiwumi, “Strangers and Sierra Leone mining: cultural heritage and sustainable development challenges,” *Journal of Cleaner Production* 84, no. 1 (2014): 773-782.
- 31 Daniel M. Franks, Rachel Davis, Anthony J. Bebbington, Saleem H. Ali, Deanna Kemp, and Martin Scurrah, “Conflict translates environmental and social risk into business costs,” *Proceedings of the National Academy of Sciences* 111, no. 21 (May 2014): 7576-7581 and Rachel Davis and Daniel Franks, *Costs of Company-Community Conflict in the Extractive Sector* (Corporate Social Responsibility Initiative, Harvard Kennedy School, 2014).
- 32 Theresa Garvin, Tara K. McGee, Karen E. Smoyer-Tomic and Emmanuel Ato Aubynn, “Community-company relations in gold mining in Ghana,” *Journal of Environmental Management* 90, no. 1 (2009): 571-586.
- 33 Kellogg Innovation Network, www.kinglobal.org. Accessed 19 March 2019.
- 34 For example, Mining, Minerals and Sustainable Development Project (MMSD) of the International Institute for Environment and Development, *Breaking New Ground: Mining, Minerals and Sustainable Development* (2002).

Some of these voluntary standards and codes, which at times exceed regulatory requirements in host countries, include:

- International Organization for Standardization (ISO) 14001:2015 for Environmental Management Systems³⁵
- The International Council on Metals and Mining (ICMM)'s 10 Principles for Sustainable Development³⁶
- The Organisation for Economic Cooperation and Development (OECD)'s Guidelines for Multinational Enterprises³⁷
- The United Nations (UN) Global Compact³⁸
- The International Labour Organization (ILO) Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy³⁹
- The World Bank Environmental and Social Framework⁴⁰
- The International Finance Corporation's Performance Standards⁴¹
- The United Nations Guiding Principles on Business and Human Rights⁴²
- The International Cyanide Management Code⁴³

There are a number of criticisms of the proliferation of voluntary standards in the extractive sector, including the fact that failure to adhere to a voluntary standard does not typically result in any punitive actions from host governments or markets.⁴⁴

Global capital markets typically require extractive companies who are publicly listed to demonstrate that they are managing their environmental and social risks.⁴⁵

35 ISO 14001:2015 "specifies the requirements for an environmental management system that an organization can use to enhance its environmental performance." See www.iso.org/standard/60857.html. The ISO is an independent, non-governmental international organization of 162 national standards bodies.

36 These serve as a best-practice framework for sustainable development in the mining and metals industry. See www.icmm.com/en-gb/about-us/member-commitments/icmm-10-principles. See also the ICMM Water Stewardship Framework available at www.icmm.com/water-stewardship-framework. The ICMM also commissioned the report, "Approaches to understanding development outcomes from mining," which details methods available to measure human and social development contributions and considers the applicability of such methods to assess mining companies' development impact. See Daniel Franks, Cristian Parra, and Ashlee Schleger. *Approaches to understanding development outcomes from mining* (International Council on Mining and Metals, 2013).

37 The guidelines "are recommendations addressed by governments to multinational enterprises operating in or from adhering countries," providing "non-binding principles and standards for responsible business conduct..." Organisation for Economic Co-operation and Development, *Annual Report on the OECD Guidelines for Multinational Enterprises* (2018), www.oecd.org/corporate/mne.

38 The UN Global Compact is a "voluntary initiative based on CEO commitments to implement universal sustainability principles and to take steps to support UN goals." See www.unglobalcompact.org/about.

39 Providing "direct guidance to enterprises...on social policy and inclusive, responsible and sustainable workplace practices." International Labor Organization, *Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy (MNE Declaration)* (2017), www.ilo.org/empent/areas/mne-declaration/lang--en/index.htm.

40 World Bank, *Environmental and Social Framework* (2018), www.worldbank.org/en/projects-operations/environmental-and-social-framework.

41 International Finance Corporation, *Performance Standards* (2012), www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/Sustainability-At-IFC/Policies-Standards/Performance-Standards.

42 United Nations, *Guiding Principles on Business and Human Rights* (2011), www.ohchr.org/Documents/Publications/GuidingPrinciplesBusinessHR_EN.pdf.

43 International Cyanide Management Institute, *International Cyanide Management Code* (2018), www.cyanidecode.org.

44 Neil Gunningham and Darren Sinclair, "Regulatory Pluralism: Designing Policy Mixes for Environmental Protection," *Law and Policy* 21 (1) (2002), 49-76.

45 Extractive companies seeking financing from the World Bank, or commercial banks that have adopted the Equator Principles (see equator-principles.com), must comply with these environmental and social requirements, which include broad commitments to disclosing social and environmental risks and reporting social and environmental impacts. The Equator Principles are based on the IFC Performance Standards on Environmental and Social Sustainability. See www.ifc.org/wps/wcm/connect/115482804a0255db96fbfd1a5d13d27/PS_English_2012_Full-Documents.pdf?MOD=AJPERES.

Investors increasingly recognize that managing environmental and social risks is necessary for maintaining long-term market value. Private sector initiatives to standardize sustainability accounting, measurement and reporting—such as the Natural Capital Protocol, the Global Reporting Initiative (GRI) Sustainability Reporting Standards, Integrated Reporting (<IR>), and Sustainability Accounting Standards Board (SASB) standards and framework—are used to help investors and lenders make more informed decisions about the risk profile presented by the sustainability practices of extractive companies. (See Box 2.)^{46,47,48,49}

Box 2. Standardizing environmental impacts measurement—ISO Standards, Natural Capital Protocol

ISO 14007 - Environmental management: Determining environmental costs and benefits – Guidance will offer guidance to organizations on determining and communicating the environmental costs and benefits of their activities on natural resources and ecosystem services.⁵⁰ The standard is meant to be applicable to any size or type of organization and to all environmental aspects. It will provide guidance on decisions that organizations make in identifying and setting the boundaries of the environmental costs and benefits of their activities and selecting the type of data to use in determining these costs and benefits. Work on the draft was approved in July 2016 and publication is expected in 2019.

ISO 14008- Monetary valuation of environmental impacts and related environmental aspects aims to provide a new standard on monetary valuation of environmental impacts and aspects.⁵¹ The standard is not meant to be prescriptive. Instead, it provides organizations with a common framework for monetary valuations, including established methods and common terms within the field of monetary valuation. The standard is meant to provide “much needed transparency and a common language” on how monetary valuations are done, by including requirements on documentation and justification of valuation methods chosen by an organization.

The Natural Capital Protocol offers “a standardized framework to identify, measure and value impacts and dependencies on natural capital in order to inform organizational decisions.”⁵² The protocol’s structure covers four stages, “why,” “what,” “how” and “what next,” each consisting of specific questions to guide integration of natural capital into organizational processes such as risk mitigation, sourcing, supply chain management and product design. It is designed for use at different levels of analysis, including product, project or organizational level and by organizations of various sizes and various business sectors. It aims to address the problem of either exclusion of natural capital considerations from decision-making or inclusion that is “inconsistent,” open to interpretation, limited to moral arguments or based on incomplete understanding of organizational relationships to natural capital.” The protocol offers a framework for a standardized process but is not prescriptive on choice of specific tools, methods or approaches. The protocol was developed by the Natural Capital Coalition, a global multi-stakeholder collaboration that brings together leading global initiatives and organizations to harmonize approaches to natural capital.

46 Natural Capital Coalition, *Natural Capital Protocol*, naturalcapitalcoalition.org/protocol/natural-capital-protocol.

47 Available at www.globalreporting.org/Information/about-gri/Pages/default.aspx.

48 See integratedreporting.org.

49 “The SASB develops and maintains sustainability accounting standards—for 79 industries in 11 sectors—that help public corporations disclose financially material information to investors in a cost-effective and decision-useful format.” www.sasb.org.

50 International Organization for Standardization, *ISO 14007 - Environmental management: Determining environmental costs and benefits – Guidance*, committee.iso.org/sites/tc207sc1/home/projects/ongoing/iso-14007.html.

51 International Organization for Standardization, *ISO 14008 - Monetary valuation of environmental impacts and related environmental aspects*, committee.iso.org/sites/tc207sc1/home/projects/published/iso-14008.html.

52 Natural Capital Coalition, *Natural Capital Protocol*.

INTERNAL MONITORING AND MANAGEMENT SYSTEMS AND CORPORATE SOCIAL RESPONSIBILITY REPORTING

Some extractive companies also carry out a range of measurement activities when monitoring the ongoing environmental and social impacts of their projects, the results of which may or may not be reported in the public domain.

For instance, on Lihir Island in Papua New Guinea, Newcrest Mining carries out an extensive program to monitor the social and economic impacts of the Lihir gold mine. It collects longitudinal data on epidemiological health impacts, population and genealogy, law and order, education outcomes and economic benefits. The company reports this data on a quarterly basis to landowners, community groups and three levels of government.⁵³ However, most extractive projects do not have a similarly advanced socio-economic monitoring program.

Extractive companies also measure and monitor a wide range of environmental impacts, including acid mine drainage impacts to land and water sources; emissions from processing; erosion and impacts to the landscape; impacts from tailings disposal facilities; loss of biodiversity; and contamination of soil, groundwater and surface water by chemicals from extractive processes. Some industry associations have sought to harmonize or standardize approaches to measuring and reporting on specific impacts, such as the global oil and gas industry association for advancing environmental and social performance IPIECA's Petroleum Industry Guidelines for Reporting Greenhouse Gas Emissions and the Minerals Council of Australia (MCA)'s Water Accounting Framework for the Minerals Industry.^{54,55}

Box 3. Minerals Council of Australia's Water Accounting Framework

Many minerals operations and companies have water accounting systems in place to measure, monitor and report water use. However, these systems are often not consistent across companies or even sites held by the same company. This can make it difficult to understand and compare industry water use by site, company, region or across sectors.

To address this heterogeneity of water accounting practice, the Minerals Council of Australia, in collaboration with the Sustainable Minerals Institute of the University of Queensland and the mining industry, developed the Water Accounting Framework for the Minerals Industry. The framework was adopted in 2011 and aligns with the Global Reporting Initiative frameworks, the Australian Water Accounting Standard and the ICMM water reporting guidance.⁵⁶

A number of guidance tools have been developed to assist mineral industry users in applying the framework, including:

- Water Accounting Framework User Guide
- Input-Output Microsoft Excel Template (Microsoft Excel 2003 compatible)
- MCA Member Adoption Explanatory Note
- Water Accounting Framework - Frequently Asked Questions

Despite these efforts, there is wide variability in the tools used by extractive companies to measure positive and negative environmental and social impacts in their monitoring programs. Moreover, the results of these monitoring programs are not always publicly disclosed or reported, leaving affected communities and the general public of host countries largely in the dark on the extent and management of ongoing impacts.

53 Newcrest Mining Limited, *Demonstrating our commitment to sustainability*, accessed 23 November 2018, www.newcrest.com.au/sustainability.

54 IPIECA, *Petroleum industry guidelines for reporting greenhouse gas emissions* (2011), www.ipieca.org/resources/good-practice/petroleum-industry-guidelines-for-reporting-greenhouse-gas-emissions-2nd-edition.

55 Minerals Council of Australia, *Water accounting framework for the Australian minerals industry*, accessed 27 November 2018, www.minerals.org.au/water-accounting-framework-australian-minerals-industry.

56 The ICMM used the Minerals Council of Australia's Water Accounting Framework as the basis for its own framework.

V. Government approaches to measuring environmental and social impacts in the extractive sector

ZOOMING OUT: ENVIRONMENTAL AND SOCIAL IMPACTS AND THE NATIONAL ECONOMY

Governments have not generally harnessed or coordinated the efforts of companies to promote more consistent measurement and reporting of environmental and social impacts of extraction.

Governments have, however, made some progress on including environmental and social aspects in analysis of the national economy and economic growth. While gross domestic product (GDP) remains the most-used macroeconomic indicator for assessing economies, there is growing recognition that measures of economic growth are inadequate when measuring the overall wealth and wellbeing of a nation. The Commission on the Measurement of Economic Performance and Social Progress (CMEPSP) conducted one prominent inquiry into the limits of GDP-based indicators in France. The report, commissioned by then President Nicholas Sarkozy in 2008, distinguished between the current wellbeing of a nation and whether this wellbeing can be sustained over time.⁵⁷ According to CMEPSP, current wellbeing is based on both economic (e.g., income) and non-economic resources (e.g., what people do, how they feel and the natural environment in which they live). Whether wellbeing can be sustained over time depends on whether stocks of capital that matter for peoples' lives—such as natural, built, human and social capital⁵⁸—are passed on to future generations.

With the increasing recognition of the need to account for national growth and wellbeing in a more holistic way, governments, multilateral organizations and academics have developed a number of initiatives and tools to promote natural capital accounting and improve the way that impacts of economic activity on environmental resources are incorporated into national wealth accounting.⁵⁹ The UN-endorsed System of Environmental Economic Accounting (SEEA) is an accounting framework that records the stocks and flows that are relevant to both the environment and the economy.⁶⁰ The European Union's Beyond GDP initiative seeks to develop indicators that are more inclusive of environmental and social aspects of progress than GDP.⁶¹ Similarly, the World Bank's *Changing Wealth of Nations* sets forth a comprehensive assessment of countries' wealth as a complementary indicator to GDP.⁶²

There is growing recognition that measures of economic growth are inadequate when measuring the overall wealth and wellbeing of a nation.

57 Joseph E. Stiglitz, Amartya Sen and Jean-Paul Fitoussi. *Report by the Commission on the Measurement of Economic Performance and Social Progress*, ec.europa.eu/eurostat/documents/118025/118123/Fitoussi+Commission+report.

58 See definitions for each capital in Section VII.

59 Natural capital accounting is the process of calculating the total stocks and flows of natural resources and services in a given ecosystem or region.

60 United Nations, *System of Environmental Economic Accounting*, seea.un.org/content/about-seea.

61 European Commission, *Beyond GDP: Measuring progress, true wealth, and well-being* (2019), ec.europa.eu/environment/beyond_gdp/index_en.html.

62 Glenn-Marie Lange, Quentin Wodon and Kevin Carey. *The Changing Wealth of Nations 2018: Building a Sustainable Future* (World Bank, Washington, D.C., 2018), openknowledge.worldbank.org/handle/10986/29001 License: CC BY 3.0 IGO.

Box 4. The System of Environmental Economic Accounting (SEEA)

The SEEA is an accounting framework that brings together economic and environmental information to measure the condition of the environment, the contribution of the environment to the economy and the impact of the economy on the environment. Its structure is similar to that of the System of National Accounts, allowing for the integration of environmental and economic statistics.⁶³

Currently the SEEA consists of: (1) the SEEA Central Framework, the first international standard for environmental-economic accounting, (2) the SEEA Experimental Ecosystem Accounting, a presentation of current knowledge in ecosystem accounting and (3) the SEEA Applications and Extensions, which illustrate how accounts based on the SEEA Central Framework can be used in policymaking, research and analysis.

The UN Statistical Commission adopted the SEEA Central Framework as the first international standard for environmental-economic accounting in 2012 and as of 2017, there were SEEA programs in 69 countries.

Further, Wealth Accounting and Valuation of Ecosystem Services (WAVES) is a World Bank-led global partnership that brings together a broad coalition of UN agencies, governments, international institutes, non-governmental organizations and academics to implement natural capital accounting, where there are internationally agreed-upon standards, and to develop approaches for other ecosystem service accounts.⁶⁴ WAVES supports country implementation of SEEA.

ZOOMING IN: ENVIRONMENTAL AND SOCIAL IMPACTS AND THE EXTRACTIVE INDUSTRY

While some progress has been made on a more holistic assessment of economies and economic growth, measurement of environmental and social impacts in assessing the economic contribution of the extractive sector to society remains limited.

At the national level, it is now fairly common for country laws to require companies to undertake ESIA.⁶⁵ Many international guidelines on good practice for conducting ESIA and managing environmental and social impacts also exist.⁶⁶

However, ESIA legislation in the NRG priority countries studied tends to provide high-level guidance on process for conducting ESIA but does not include set standards or requirements for quantifying environmental and social impacts in monetary or other units. The exact tools and methods used to quantify these impacts is typically left to the discretion of extractive companies and their consultants.

Measurement of environmental and social impacts in assessing the economic contribution of the extractive sector to society remains limited.

63 "The System of National Accounts (SNA) is the internationally agreed standard set of recommendations on how to compile measures of economic activity." United Nations, *System of National Accounts* (2019), unstats.un.org/unsd/nationalaccount/sna.asp.

64 World Bank, *Wealth Accounting and the Valuation of Ecosystem Services*, www.wavespartnership.org/en/about-us.

65 Of the 81 countries covered by the 2017 Resource Governance Index, 26 require companies to conduct environmental and social impact assessments in at least one of their extractive sectors: Afghanistan, Angola, Australia (Western), Bolivia, Burkina Faso, Cambodia, Cameroon, Chile, Congo, DRC (oil and gas), Guinea, Indonesia (mining), Indonesia (oil and gas), Iran, Kuwait, Lao PDR, Mali, Mexico (oil and gas), Myanmar (mining), Myanmar (oil and gas), Niger, Norway, Papua New Guinea, Peru, Philippines, South Sudan, United Kingdom, Uzbekistan. The Environmental Law Alliance Worldwide has also developed an EIA Law Matrix, which provides information on the EIA laws and regulations for selected countries. The database is available at elaw.org/elm. Sometimes human rights impact assessments may also be included.

66 For example, IFC Performance Standards on Environmental and Social Sustainability, Performance Standard 1, Assessment and Management of Environmental and Social Risks and Impacts (2012) and Frank Vanclay, Ana Maria Esteves, Ilse Aucamp and Daniel M. Franks, *Social Impact Assessment: Guidance for assessing and managing the social impacts of projects* (International Association for Impact Assessment, 2015).

And while country laws may require strategic impact assessments (or strategic environmental assessments) before opening an area for licensing, our review suggests that it is uncommon in NRGIs' priority countries, to use valuation tools which allow for environmental and social impacts to be integrated into economic models of extractive projects.⁶⁷

Box 5. Examples of ESIA requirements in a sample of NRGi priority countries

The environmental impact assessment (EIA) process in Nigeria follows the Nigerian Environmental Impact Assessment Decree No. 86 of 1992, which provides high-level guidance on the EIA requirements and process. The minimum provisions for EIA required by the act do not provide specific guidance on how to measure or value environmental impacts, but instead require:

"...

- a a description of the proposed activities;
- b a description of the potential affected environment including specific information necessary to identify and assess the environmental effects of the proposed activities;
- c a description of the practical activities, as appropriate;
- d an assessment of the likely or potential environmental impacts on the proposed activity and the alternatives, including the direct or indirect cumulative, short-term and long-term effects;
- e an identification and description of measures available to mitigate adverse environmental impacts of proposed activity and assessment of those measures;
- f an indication of gaps in knowledge and uncertainty which may be encountered in computing the required information;
- g an indication of whether the environment of any other State, Local Government Area or areas outside Nigeria is likely to be affected by the proposed activity or its alternative;
- h a brief and non-technical summary of the information provided under paragraph (a) to (g) of this section."

In Indonesia, the guidance for EIAs provided in the Environmental Protection and Management Law (2009) provides the following general guidance on measurement of impacts in the EIA process.⁶⁸ According to Article 25 of the act, EIAs shall contain:

"...

- study on impact of business and/or activity plan;
- evaluation of activities around the location of business and/or activity plan;
- public recommendation, input as well as response to business and/or activity plan;
- estimate of the coverage and important characteristic of the occurring impact if the business and/or activity plan is/are executed;
- holistic evaluation of the occurring impact to determine environmental feasibility or unfeasibility; and
- environmental management and monitoring plan."

67 For example, Ghana Petroleum (Exploration and Production) Act, 2016, section 7. Strategic impact assessments or strategic environmental assessments are used to assess the wider environmental, social and economic impacts of a government policy, program or plan, whereas ESIA's are used to determine the potential impacts of a specific project. See, generally, United Nations Environment Programme, *Assessing Environmental Impacts-A Global Review of Legislation* (2018), available at europa.eu/capacity4dev/unep/documents/assessing-environmental-impacts-global-review-legislation.

68 See also Netherland Commission for Environmental Assessment, *Indonesia Country Profile*, accessed 19 March 2019, www.eia.nl/en/countries/as/indonesia/eia.

Colombia is one of the few countries reviewed that explicitly requires quantitative assessment. Developed by the Ministry of the Environment and Sustainable Development, the methodology for environmental studies in Colombia specifies that EIAs will include the following areas:

- Physical (geology, hydrology, quality of air, water and soil, water, climate, noise)
- Biological (ecosystems, flora and fauna)
- Socio-economical
- Landscape
- Archaeological
- Environmental management plan
- Zoning of environmental management measures
- Monitoring Program
- Contingency plan
- Abandonment and final restoration plan^{69,70}

Quantitative and qualitative assessment criteria include the area of influence, magnitude, duration, resilience, reversibility, periodicity, type and possibility of occurrence of impacts. Regulation requires an economic evaluation of the positive and negative impacts of the projects and may also require an environmental cost-benefit analysis of alternatives.⁷¹

In Tunisia, EIAs submitted to the Agence Nationale de Protection de l'Environnement (ANPE) must contain the following:

- Project description
- Baseline data
- Analysis of impacts
- Justification for the project
- Mitigation measures
- Additional requirements may be specified in the individual terms of reference supplied by ANPE⁷²

There are, however, no requirements on extractive companies to quantify impacts in monetary or other unit terms for environmental and social impact assessments.

In some cases, terms of reference (ToRs) for ESIA can go into additional detail not provided by laws, regulations or guidelines. The extractive company (or the consultant hired to conduct the ESIA) may write these ToRs, which are then reviewed by the relevant regulatory authority.

There have been attempts by some regulatory bodies to standardize ESIA ToRs. For instance, in Queensland, Australia, the Environmental Protection Act 1994 (EP Act) sets the purpose of the ESIA process but does not prescribe the specific content requirements for ESIA documentation. The EP Act requires that the Department of Environment and Heritage Protection (EHP) set out the content, develop, and approve ToRs for each ESIA under the EP Act.

69 Colombia, Ministry of Environment and Sustainable Development, *Metodología General para la Presentación de Estudios Ambientales normado por la Resolución 1503 -2010* (2010) and Colombia, Ministry of Environment and Sustainable Development, *Manual de Evaluación de Estudios Ambientales, Criterios y Procedimientos* (2002).

70 Netherland Commission for Environmental Assessment, *Colombia Country Profile*, accessed 19 March 2019, www.eia.nl/en/countries/sa/colombia/eia.

71 Colombia, Ministry of Environment and Sustainable Development, *Decreto Número 2041 "Por el cual se reglamenta el Título VIII de la Ley 99 de 1993 sobre licencias ambientales"* (2014).

72 Tunisia, *Décret N°1991 du 11 juillet 2005*.

Formerly, ToRs were developed on a case-by-case basis. However, in 2013 the EHP issued a generic draft ToR for resource project ESIA's under the EP Act. These new standard ToRs assist the development of project-specific ToRs that specify the minimum expectations for ESIA's.

To accompany these standard ToRs, guidelines have also been developed to clarify the types of information and level of detail required in an ESIA. The guideline is a compilation of relevant technical guidance material, arranged following the subject headings in the generic ToRs. It is intended to be used alongside the generic ToRs and to help ESIA project proponents successfully prepare an ESIA under the EP Act.

While these guidelines are quite extensive in outlining the types of impacts that should be assessed in the ESIA process, they are generally not prescriptive about the approach for measuring or valuing impacts. More detailed resources are provided as “useful references and guidelines.”⁷³

An example of a regional initiative to develop standard ToRs and guidance materials is the U.S. Environmental Protection Agency's collaboration with partners to the Central America and Dominican Republic Free Trade Agreement (CAFTA-DR). Through the collaboration, EIA Technical Review Guidelines for three priority sectors have been developed: energy, mining and tourism. The guidelines aim to strengthen the EIA process for government officials, non-governmental organizations and the general public throughout the life of the projects.⁷⁴

Although the standard ToRs present a comprehensive list of the different types of impacts to be assessed through the ESIA process, no guidance on measurement or valuation is provided in the ToRs. The accompanying Technical Review Guidelines for governments, however, provide detailed information about how ESIA's should be evaluated against mining sector-specific performance standards for areas such as water discharge and effluent limits; discharge from waste rock; and air emission limits for the mining sector. This information is based on various environmental standards in place in the countries in CAFTA-DR partner countries.

Box 6. Excerpt of CAFTA-DR example terms of reference: Non-metal and mining (Volume 1, Part 2)

6. Assessment of Impacts

The EIA shall provide information on potential impacts (direct, indirect and cumulative), and both the magnitude and frequency of potential impacts on physical, biological, social-economic-cultural resources potentially resulting from the proposed project and alternatives. The assessment shall use standardized predictive methods, such as models, to determine the specific range of impacts on environmental and socio-economic resources. The EIA shall identify which impacts are significant and the criteria used to make this judgment. Critical data input from project description and environmental setting analysis projecting the conditions in the environmental setting in the absence of the proposed project shall be used as the baseline upon which potential impacts are forecast. The EIA shall also identify sources of data used in the analysis and the uncertainties associated with the outputs of each method used.

73 Queensland Government, Department of Environment and Science, *Information guideline for an environmental impact statement*, accessed 23 November 2018, environment.des.qld.gov.au/management/impact-assessment/eis-processes/eis-tor-support-guidelines.html.

74 United States Environmental Protection Agency, *EIA Technical Review Guidelines for the Mining Sector*, accessed 26 November 2018, www.epa.gov/international-cooperation/eia-technical-review-guidelines-mining-sector.

Physical Impacts

...

6.2 Soil Resources

Potential impacts to land resources shall be described including but not limited to the following:

6.2.1 Soil quality

6.2.1.1 Contamination by mining wastes (water and air bourn [sic])

6.2.1.2 Impacts on use

6.2.2 Erosion

6.3 Water Resources

Potential impacts to surface water and groundwater resources during mine construction, operation and post-closure shall be described including but not limited to the following:

6.3.1 Geomorphology

6.3.1.1 Modification/diversion in the existing drainage pattern

6.3.1.2 Downstream scouring and upstream head cutting

6.3.1.3 Bank erosion (surface water discharges, stream crossings and dredging)

6.3.1.4 Potential for increased flash flooding

6.3.2 Quantity

6.3.2.1 Water bodies likely to be created due to mining activities

6.3.2.2 Impact of water withdrawal, dewatering and mine operation on surface water and groundwater

- Model results
- Water table levels
- Well production
- Spring and stream flows

6.3.2.3 Effects of dams on downstream seepage....

Greater standardization of what impacts are measured, how they are measured, when they are measured and which measurements might require valuation, can help to improve the regulation and management of impacts across the extractives sector.

Overall, then, government legislation and guidelines often specify the types of impacts that an ESIA should measure, but typically do not provide guidance on measurement or valuation tools and methods. Instead, the selection of measurement methods and tools is typically left to extractive companies and their consultants. While such discretion has some advantages,⁷⁵ it can also result in a multiplicity of approaches when measuring or modeling the impacts of extractive projects with varying levels of specificity. Lack of consistent approaches not only risks under-measurement but can also make it challenging to compare impacts and management of these impacts across projects, or to assess cumulative impacts of multiple projects. Greater standardization of what impacts are measured, how they are measured, when they are measured and which measurements might require valuation, can help to improve the regulation and management of impacts across the sector.

Further, our review suggests that, beyond requirements for ESIA's and strategic impact assessments, NRG priority-country governments are generally not using measurement of environmental and social impacts to inform their own policymaking on the extractive sector.

⁷⁵ For instance, allowing extractive companies to select fit-for-purposes methodologies that meet project requirements.

VI. Modeling and measuring environmental and social impacts in extractive sector decision-making

More effective modeling and measurement of the environmental and social impacts of extraction could inform a range of government policy and regulatory decisions, including:

- **The decision to open an area for extraction.** Modeling of as many of the potential material impacts as possible before extraction can allow for an understanding of how expected revenues and positive impacts like employment are likely to compare with the cost of negative environmental and social impacts, such as pollution (and its resulting effects on other livelihoods like fishing or farming) or inward migration.
- **Compensation schemes for affected communities.** Modeling or measuring the potential or actual material impacts of extraction on communities can serve as inputs for determining how much compensation is actually required to restore or improve the living standards of affected communities. A focus merely on loss of land, for example, may not capture the full impacts on communities, including those that do not lose land but whose livelihoods are nevertheless affected.⁷⁶ Compensation based only on land lost may therefore be inadequate.
- **Design of community development programs.** Modeling or measuring impacts over time can help governments and/or companies more effectively tailor community development programs to minimize costs and maximize benefits to communities from extraction.
- **Revenue transfers from central government to resource-producing areas.** If such transfers are based in whole or in part on compensation for impacts, measuring and valuing the positive and negative impacts over time may help countries assess whether transfers to local governments in resource producing areas or central government expenditure in these areas are sufficient or well-targeted.
- **Design of regulations to promote a positive impact (local content regulations) or reduce a negative impact (environmental regulations) of extraction.** Modeling or measuring the impact of regulations can help policymakers understand tradeoffs. Regulations might result in increased costs to extractive companies in complying with these regulations (which may reduce profits and revenues to the government from extractive projects). But they might create positive impacts to other sectors in the economy through creation of jobs or reduction in pollution that negatively affects productivity of other sectors, for example, agriculture.

The scope of the measurement will depend on the objectives of the measurement exercise. A “total impacts”⁷⁷ approach may be most suitable for decisions on opening an area for extraction or possibly assessing appropriate compensation or revenue-transfer schemes. On the other hand, more limited or targeted measurement may be useful for evaluating the impacts of a proposed regulation or designing community development programs to address a specific issue highlighted by communities or local governments.

⁷⁶ For example, due to the effect of pollution on agricultural productivity or on fishing.

⁷⁷ Many or all material impacts.

Similarly, *ex ante* modeling of potential impacts can provide more information for designing regulations and making decisions before extraction takes place. Whereas *ex post* measurement allows for quantifying the impacts that actually occurred, reviewing assumptions based on real-world experience and applying lessons learned to review or revise regulation of ongoing projects or subsequent projects.

TOTAL IMPACTS MEASUREMENT

There are reasons to be cautious about attempts to measure “total impacts,” particularly in monetary terms, not least because some stakeholders consider some impacts (for example, those of a spiritual or cultural nature) “unquantifiable” or “invaluable.” Therefore, while measurement may be part of a decision-making process, it cannot and should not be solely determinative of whether extractive projects proceed or how they are managed. Nevertheless, attempts to quantify as many material impacts as possible across all of the capitals can facilitate a more concrete and informed public discussion on what the country stands to gain and lose from extraction—and on how to make the most of extraction, should it proceed. Where quantification is not possible or appropriate, qualitative analysis can provide a strong complement to quantitative analysis, providing the contextual information needed to give meaning to the numbers.

For example, the 15 Pacific states of the Africa, Caribbean and Pacific Group of States requested assistance from the Secretariat of the Pacific Community as they considered the implications of deep-sea mining in their jurisdictions.^{78,79} The Secretariat, with the support of the European Union, commissioned a preliminary cost-benefit analysis based on hypothetical mining scenarios developed for three mineral deposits believed to have a high potential for economic viability.⁸⁰ To the extent possible, costs and benefits were quantified and monetized, but impacts that could not be quantified were considered and discussed qualitatively. The study estimated employment effects and value addition supported by mining operations’ expenditures and included an analysis of potential distribution effects: that is, identification of who would bear the costs and who would receive benefits. Finally, in addition to the cost-benefits analyses of the three potential mine sites, the study used a regional economic impact model to assess the local employment and income effects associated with the operation of the three mine sites and compared these effects to annual projected royalties from mining. The study found a net benefit of deep-sea mining for the deposits in Papua New Guinea and the Cook Islands but not the Republic of Marshall Islands.

Measurement should not be solely determinative of whether extractive projects proceed. Nevertheless, attempts to quantify as many material impacts as possible can facilitate a more concrete and informed public discussion on what the country stands to gain and lose from extraction.

78 The African, Caribbean and Pacific Group of States (ACP) is an organization created by the Georgetown Agreement in 1975, consisting of 79 African, Caribbean and Pacific states. There are 48 countries from Sub-Saharan Africa, 16 from the Caribbean and 15 from the Pacific. See www.acp.int/content/secretariat-acp.

79 The International Seabed Authority is in the process of developing a mining code to regulate prospecting, exploration and exploitation of marine minerals in the international seabed area. See www.isa.org.jm/mining-code.

80 Cardno for the Pacific Community, *An Assessment of the Costs and Benefits of Mining Deep-sea Minerals in the Pacific Island Region: Deep-sea Mining Cost-Benefit Analysis* (2016), [www.seabedmineralsauthority.gov.ck/PicsHotel/SeabedMinerals/Brochure/An Assessment of the Costs and Benefits of Mining Deep Sea Minerals_.pdf](http://www.seabedmineralsauthority.gov.ck/PicsHotel/SeabedMinerals/Brochure/An%20Assessment%20of%20the%20Costs%20and%20Benefits%20of%20Mining%20Deep%20Sea%20Minerals_.pdf).

Box 7. Total impacts measurement tool: PwC’s Total Impact Measurement and Management

<p>Type Tool</p> <p>Intended User Companies, Government, NGOs / Academia</p> <p>Impact Type Total Impacts</p> <p>Capital Financial, Human, Natural, Social</p> <p>Level of Analysis Company, Project, Sector</p> <p>Actual or Projection Actual, Projection</p> <p>Assessment/Valuation Monetary valuation, Quantitative</p> <p>Complexity High</p> <p>Comparability High</p> <p>Mining / Oil & Gas Mining, Oil & Gas</p> <p>Gender Sensitive Unknown</p> <p>Status Active</p>	<p>Developer PricewaterhouseCoopers (PwC)</p> <p>Description A proprietary tool developed by PwC, Total Impact Measurement & Management (TIMM) enables users to develop a better understanding of the social, fiscal, environmental and economic impacts of their activities. The tool compares the total impacts of different business strategies and scenarios. The method quantifies and monetizes sustainability impacts, but also accounts for and integrates fiscal bottom line profit implications.</p> <p>Web link https://www.pwc.com/au/en/services/sustainability/publications/total-impact-measurement-management.html</p> <p>Measurement Monetary Step 1 – Define scope » What’s the objective? To determine the right investment choice? Or demonstrate value to stakeholders? Step 2 – Define dimensions of value » How far do the impacts reach? Map total impacts Step 3 – Collect existing data » What information can be provided? Step 4 – Source new data » What additional information is required and how can it be generated? Step 5 – Analyze data and value impacts » What is the value of the impacts? Put an economic and social value on impacts. Involves using techniques such as economic and process modelling</p> <p>Data Inputs Required Data needs are determined once the salient impacts have been identified and methodologies for quantifying and monetizing impacts are established.</p> <p>Examples of data requirements are: salaries, tax payments, resource use (i.e. energy, water, waste etc), investment/CAPEX spend, procurement and expense figures, subsidies received, H&S statistics, training programs (e.g. enrolment numbers, average level of education achieved)</p> <p>Supporters PricewaterhouseCoopers (PwC)</p> <p>Users BASF, Siemens, Galp Energy, Kering, Travel Foundation and TUI Group, St Giles Trust, SHE Transmission, PwC UK</p> <p>Extractive Company Use Galp Energie</p> <p>Adaptability Could be used in the extractive industries. (Highly applicable - showcased at London School of Mines).</p> <p>Strengths » Monetization of all impacts (social, environmental and economic) » Comparability between impact areas » Can be applied at multiple levels (from site to country to global) » Utilizes » Actionable results. » Actionable results. » Quality visualization aspects.</p> <p>Limitations » The tool is proprietary and requires the user to engage PwC. » Due to its proprietary nature, details about the methodology are not available.</p> <p>Cost Variable, would need to engage PwC as a project consultant. Fees would vary depending on nature of project and engagement.</p> <p>Training Available No</p> <p>Training Details Tool accessed through consultant engagement.</p>
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Past mine tailing disasters in the Philippines motivated the non-profit organization, ABS-CBN Lingkod Kapamilya Foundation, Inc.- Bantay Kalikasan, to engage three state universities and colleges to carry out “Resource Accounting or Full-Cost Benefit Analysis Studies” (or total economic valuation, TEV) of the environmental impacts of mining operations in three mining provinces: Palawan, Oriental Mindoro and Albay.⁸¹ The organization sought to determine: “[i]s there any way in which the benefits of largescale mining can be measured and be compared with the environmental costs?” Each university formed an interdisciplinary team of experts to carry out the studies in their respective provinces and each team received training and guidance from technical consultants on research methods for the studies. The study looked at both actual impacts of already operational mining projects and the projected impacts of a mining project, comparing environmental costs—in terms of negative impacts on health, biodiversity, socio-cultural resources, forests, agriculture, water resources and

81 Bantay Kalikasan is the environmental program of ABS-CBN Lingkod Kapamilya Foundation. See corporate.abs-cbn.com/lingkodkapamilya/about-us for more on the organization.

tourism potential—with the economic benefits of mining in the form of employment, taxes, royalties and mining companies’ community development contributions through the Social Development and Management Programs required by law.⁸² Results showed mining costs outweighed benefits in all three areas studied.

The study did acknowledge challenges with the total economic valuation approach: TEV studies are expensive, time-consuming, require highly technical skills and expertise and can be misused by decision-makers. Nevertheless, the study recommended including TEV in the planning and implementation of mining projects to guide decision-making.

Box 8. How much is the Great Barrier Reef worth?

In 2016, the Great Barrier Reef Foundation, with the support of the National Australia Bank and the Great Barrier Reef Marine Park Authority (GBRMPA), commissioned Deloitte Access Economics to assess the total economic and social value of the Great Barrier Reef. The report built on earlier work commissioned by the GBRMPA to analyze the annual economic contribution of the Great Barrier Reef.⁸³

The study did not seek to address an imminent policy question but was motivated by a significant bleaching event and resulting public dialogue on whether enough was being done to protect the reef. Per the study itself, “identifying, measuring and reporting on the economic and social value of the environment elevates its significance in decision making. Valuing nature in monetary terms can effectively inform policy settings and help industry, government, the scientific community and the wider public understand the contribution of the environment, or in this case the Great Barrier Reef, to the economy and society.” The study asserted that the reef’s “value does often does not come with a price tag; it cannot be bought or sold. Nor should it, because to most of us nature is priceless. However, often nature’s significance is ignored due to its value not being fully captured commercially in the economy.” Therefore, “threats to the [Great Barrier Reef] demand that the total value Australians and the international community place on it be understood in the most appropriate way possible.”

Deloitte Access Economics chose to combine both quantitative and qualitative analysis, acknowledging that not all value can or should be quantified. Quantitative analysis assessed the economic contribution of the reef in terms of value-added to the economy and creation of jobs, as well as the economic and social value created in terms of direct use value from tourism and recreation and non-use value to society. The study also examined the significance of the reef to Aboriginal and Torres Strait Islander Traditional Owners and the reef’s “brand value” to Australia and the international community in qualitative terms.

The results estimated the Great Barrier Reef’s economic, social and icon asset value at AUS 56 billion, supporting 64,000 jobs and contributing AUS 6.4 billion to Australia’s economy.

TARGETED MEASUREMENT


Beyond the fundamental question as to whether “total” impacts can or should be assessed, total impacts assessments may not always be appropriate or feasible due to the time and resources required or the nature of the policy question. Instead, targeted quantification, focused on impacts with particular policy relevance, could be a useful and at times more practical alternative.

82 ABS-CBN Lingkod Kapamilya Foundation, Inc.- Bantay Kalikasan, *Total Economic Values of the Impacts of Largescale Mining in Palawan, Oriental Mindoro and Albay* (2015).

83 Deloitte Access Economics, *At what price? The economic, social and icon value of the Great Barrier Reef* (2017), www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-great-barrier-reef-230617.pdf.

For example, the Natural Capital Project conducted ecosystem service mapping in a number of countries to assist with land use planning and prioritization of conservation and forest restoration efforts.^{84,85} Measuring ecosystem service benefits in an area can help decision-makers understand the potential cost of different land use options and evaluate alternatives. In extractive sector management, ecosystem service mapping and valuation may be most useful at the stage of strategic impact assessments before opening areas for exploration, particularly environmentally sensitive areas. The Natural Capital Project has developed a number of tools, including InVEST, a suite of free, open-source software models, which may be used to map and value ecosystem services.⁸⁶

Box 9. Mapping and valuing ecosystem services: InVEST



Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST)

<p>Type Tool</p> <p>Intended User Companies, Government, NGOs / Academia</p> <p>Impact Type General Environmental Impacts</p> <p>Capital Built, Natural</p> <p>Level of Analysis Project, Sector</p> <p>Actual or Projection Projection</p> <p>Assessment/Valuation Monetary valuation, Qualitative, Quantitative</p> <p>Complexity Medium to High</p> <p>Comparability High</p> <p>Mining / Oil & Gas Mining, Oil & Gas</p> <p>Gender Sensitive No</p> <p>Status Active</p>	<p>Developer The Natural Capital Project</p> <p>Description Integrated Valuation of Ecosystem Services and Tradeoffs is a family of tools developed by the Natural Capital Project that provides a suite of free, open-source software models used to map and value the goods and services from nature that sustain and fulfil human life. It has eighteen distinct ecosystem service models designed for terrestrial, freshwater, marine, and coastal ecosystems. Its models are spatially-explicit, using maps as information sources and producing maps as outputs. InVEST returns results in either biophysical terms (e.g., tonnes of carbon sequestered) or economic terms (e.g., net present value of that sequestered carbon).</p> <p>Web link http://www.naturalcapitalproject.org/invest/</p> <p>Measurement » Monetary (i.e. dollars of avoided damage, net revenue from recreational value) and quantitative (i.e. tonnes of carbon sequestered) » Data sets/information imported into tool and then InVEST models impact (i.e. habitat risk assessment evaluates anthropogenic risk factors to marine and terrestrial environment, land cover data – such as grassland, agriculture, forest etc – model then runs scenarios based on changes)</p> <p>Data Inputs Required Data sets/information for each of the sub- tools: habitat quality, habitat risk assessment, marine water quality, forest carbon, water yield, nutrient retention, land-cover etc</p> <table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; vertical-align: top;"> <p>Supporters STANFORD UNIVERSITY, UNIVERSITY OF MINNESOTA, THE NATURE CONSERVANCY, AND THE WORLD WILDLIFE FUND</p> </td> <td style="width: 50%; vertical-align: top;"> <p>Users GOVERNMENT OF BELIZE, NATCAP (NATURAL CAPITAL PROJECT), NATIONAL ACADEMY OF SCIENCES IN CHINA.</p> </td> </tr> </table> <p>Extractive Company Use No cases identified</p> <p>Adaptability Could be used in the extractive industries</p> <p>Strengths » Uses open-source software models » Includes spatial analysis. » Returns results in either biophysical terms (e.g., tonnes of carbon sequestered) or economic terms (e.g., net present value of that sequestered carbon).</p> <p>Limitations » Requires access to technical and subject matter expertise</p> <p>Cost Free to download</p> <p>Training Available Yes</p> <p>Training Details Yes, at the Natural Capital Symposium (annual event) and online training</p>	<p>Supporters STANFORD UNIVERSITY, UNIVERSITY OF MINNESOTA, THE NATURE CONSERVANCY, AND THE WORLD WILDLIFE FUND</p>	<p>Users GOVERNMENT OF BELIZE, NATCAP (NATURAL CAPITAL PROJECT), NATIONAL ACADEMY OF SCIENCES IN CHINA.</p>
<p>Supporters STANFORD UNIVERSITY, UNIVERSITY OF MINNESOTA, THE NATURE CONSERVANCY, AND THE WORLD WILDLIFE FUND</p>	<p>Users GOVERNMENT OF BELIZE, NATCAP (NATURAL CAPITAL PROJECT), NATIONAL ACADEMY OF SCIENCES IN CHINA.</p>		

84 The Natural Capital Project is a partnership between Stanford University, the Chinese Academy of Sciences, the University of Minnesota, The Nature Conservancy, and the World Wildlife Fund. It consists of academics, software engineers, and professionals who aim to “shine a light on the intimate connections between people and nature, and to reveal, test, and scale ways of securing the well-being of both.” Natural Capital Project, *Who We Are*, naturalcapitalproject.stanford.edu/what-is-nature-capital-who-we-are.

85 Natural Capital Project, *Where we work*, naturalcapitalproject.stanford.edu/how-do-we-know-it-works/where-we-work.

86 Natural Capital Project, *Software*, naturalcapitalproject.stanford.edu/software.

Measurement can also be used to estimate, and subsequently track, the economic impact of proposed regulations in the extractive sector. For example, the International Finance Corporation (IFC)'s Extractives Impact tool is designed to produce estimates of direct and indirect jobs created by extractive projects, based on the multiplier effect of company expenditures at various stages of the project life cycle.⁸⁷ Some adaptation of such a tool could help provide estimates of the likely impact of local content regulations in terms of indirect job creation based on scenarios in which different proportions of total company expenditure are captured locally. The contribution to the wider economy could also be compared to the impact of local content regulations on project financials, including any initial increases (and subsequent decreases) to company costs based on adhering to the regulations. These estimates could be used to design the local content regulations and develop a phased approach to local content requirements and, where appropriate, to track and adjust requirements over time.⁸⁸ They might also inform design of the fiscal terms for the project, after accounting for the impact of proposed regulations.

Measurement can be used to estimate, and subsequently track, the economic impact of proposed regulations in the extractive sector.

Finally, measurement could be useful for estimating and tracking the effect of companies' community development activities. Companies such as Rio Tinto, Newmont and Cairn Energy have all used the IFC's Financial Valuation Tool to model the effects of the sustainability investments or corporate social responsibility portfolio in terms of value protection and value creation.⁸⁹ Other tools such as the UN's Global Compact and Oxfam's Poverty Footprint Tool could also help companies measure the impact of their activities on poverty.⁹⁰

To help support the use of tools, methods and frameworks ("tools" generally) for measuring environmental and social impacts by government and non-governmental actors alike, NRGi has put together the tools we found in a database named the Tool Explorer. The Tool Explorer contains details on each tool to help users quickly determine whether the tool might be suitable for their purposes.

87 This tool is still under development. See NRGi's Tool Explorer for further details.

88 Frameworks such as the Mining Local Procurement Reporting Mechanism might also be helpful in standardizing information provided by companies on their procurement practices. The German Federal Ministry for Economic Cooperation and Development (BMZ) through GIZ commissioned the framework, which was created by the Mining Shared Value initiative of Engineers Without Borders Canada. See miningsharedvalue.org/mininglprm. Further, the German Federal Institute for Geosciences and Natural Resources (BGR) has developed the Local Investment Opportunities in Natural Resource Projects (LION) model, which provides estimates of mining company operating expenditures disaggregated by cost category. This tool can help governments shape local procurement regulations and local supplier development programs based on estimates of company demand for different products. See www.extractiveshub.org/topic/view/id/12/chapterId/537.

89 See www.fvtool.com/case-studies-riotinto for case studies of extractive companies' application of the tool.

90 United Nations, *Assess Your Impact on Poverty*, www.unglobalcompact.org/take-action/action/poverty-footprint.

VII. The Tool Explorer

We organized the tools in the database by impact areas. Each tool includes the following information:

<ul style="list-style-type: none"> • Type • Developer • Description • Web-link • (Process of) measurement • Data inputs required • Supporters of tool • Users of tool • Use by extractive companies • Adaptability of tool for use in extractive sector • Strengths and limitation of tool • Cost • Availability of training for use of tool 	<ul style="list-style-type: none"> • Details of training • Intended user of tool • Type of impact measured • Capital measured • Level of analysis • Actual or projected impacts measurement • Monetary valuation • Gender sensitivity • Intended for mining or oil/gas • Complexity • Comparability (ease of comparison of results from use of tools across different cases) • Active or inactive status • Method employed by tool
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To find existing tools, first, we conducted a series of search-engine searches to identify research articles and applied reports that contained descriptions of tools and methods for measuring environmental and social impacts across capitals. The purpose of these searches was twofold: (a) to systematize the approach for identifying tools and methods and (b) to gather descriptive data on the popularity of tools and methods.

Collectively, the searches returned a total of 379 articles and reports that identified tools and methods for measuring environmental and social impacts. We analyzed meta-data recorded from the search engine searches to identify the frequency of tools and methods across the capitals, specific areas of impact, industries, levels of analysis and measurement types.

We created two databases: an articles database containing all articles and reports identified in the search-engine searches, and a tools database containing all tools and methods identified in the search-engine searches. The purpose of the articles database was to assess the usage of tools and methods in the academic and applied literature. The purpose of the tools database was to produce descriptive data on methods and tools.

We also used a stakeholder questionnaire to identify other stakeholders who are working on tools and methods to measure environmental and social impacts in the extractive sector.

We publicized the questionnaire on social media platforms and blogs. A total of 27 people completed the questionnaire, representing extractive companies, multilateral or donor organizations, consulting companies, governments or regulators, academic or training institutions, non-governmental organizations and other types of entities.

CAPITALS FRAMEWORK

To aid the review of these environmental and social impact measurement tools, our research adopted a “capitals” framework, which has been used in the extractive sector as a way to categorize the broader range of positive and negative impacts that occur from extractive projects.⁹¹

A “capital” is a stock of something of value that can be enhanced or depleted. There are various approaches to capitals grouping, including the five capitals approach used by British environmental writer Jonathon Porritt: natural capital, physical capital, social capital, human capital and financial capital.⁹² To identify the specific forms of capital measured in the tools included in the database, the approach adopted a more granular version of the capital framework. (See box 10.)

Box 10. Capitals framework

- **Social capital.** Social networks and trust; social rules, norms and obligations; and the reciprocity arrangements embedded in social relations and social structures
- **Human capital.** Levels of knowledge and skill; informal and formal education; the health and nutrition of individuals; as well as their motivation and aptitude
- **Cultural and spiritual capital.** The way people know the world and their place within it; the extent to which local culture, values, traditions, language and religion promote or hinder wellbeing, social inclusion and social development
- **Political capital.** The existence and effective functioning of society’s governance mechanisms, including the governance institutions themselves, as well as the standards, rules and regulations they apply
- **Financial capital.** The financial resources available to society’s institutions, groups and individuals
- **Built capital.** The stock of equipment, physical plant (e.g. factories), infrastructure (e.g. roads, airports, hospitals, schools) and other productive resources owned by individuals, the business sector, or the country itself, as well as the management systems needed to make them work
- **Natural capital.** The stocks and flows of environmentally-provided assets (i.e. ecosystem services) such as soil, agricultural resources, mineral reserves, air, water, wetlands and all living things
- **Intellectual capital.** The collective knowledge of the individuals in an organization or society

91 See, for example, Frank Vanclay, Ana Maria Esteves, Ilse Aucamp and Daniel Franks, *Social Impact Assessment: Guidance for assessing and managing the social impacts of projects* (International Association for Impact Assessment, 2015).

92 Jonathon Porritt, *Capitalism as if the World Matters* (Routledge, 2015).

TOTAL NUMBER OF TOOLS IDENTIFIED

We identified a total of 58 tools, employing one or more measurement methods through the search engine searches, stakeholder interviews and questionnaires.

Box 11. Measurement methods

Cost-benefit analysis. Cost-benefit analyses typically compare the strengths and weaknesses of alternative options or scenarios—such as different business activities, projects or policies—as a basis of comparing investment decisions.

Ecosystem services. The ecosystem services (ES) valuation process places values on various ecosystem services (provisioning, regulating, habitat, cultural) and then determines how these values will change as a result of planned activities, such as the construction of new buildings or land razing to make way for the planting of new crops.

Footprinting. Ecological footprint methods quantify the impacts of human activities measured in terms of the area of biologically productive land and water required to produce the goods consumed and to assimilate the wastes generated.

Impact assessment. Environmental impact assessment (EIA) is the process of assessing the likely environmental impacts (positive and negative) of a plan, policy, program, or project. Social impact assessments (SIAs), which are sometimes included within an EIA, focus on the social impacts of the proposed activity.

Input-output. The input-output model (IOM) is a quantitative economic method used to assess the inputs and outputs through an organization, industry or economy.

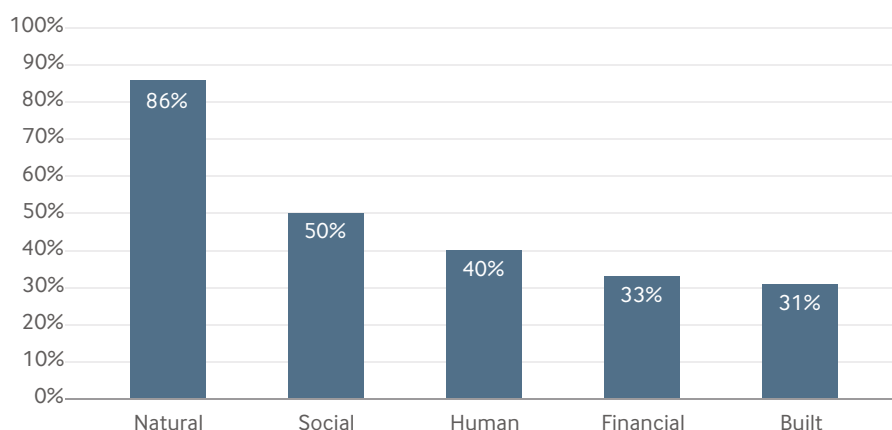
Life Cycle assessment. Life cycle assessment (LCA) is a method for the evaluation of the environmental aspects of a product or service system through all stages of its life cycle.

Triple bottom line. The triple bottom line (TBL) method is an accounting framework that incorporates three dimensions of performance: social, environmental and financial.

MOST COMMON CAPITALS

Fifty tools (86 percent) take natural capital into account. (See figure 1.) Social capital (50 percent) is the next most frequently occurring capital, followed by human capital (40 percent), financial capital (33 percent) and built capital (31 percent).

Figure 1. Tools by capital type



The bias towards tools that quantify impacts to natural capital is not surprising, given that the field of environmental accounting is more established than social accounting, and arguably lends itself towards more quantitative assessments. Generally speaking, tools that quantify impacts to other forms of capital such as human capital, cultural capital or built capital measure these types of impacts within a general methodology to measure total impacts.

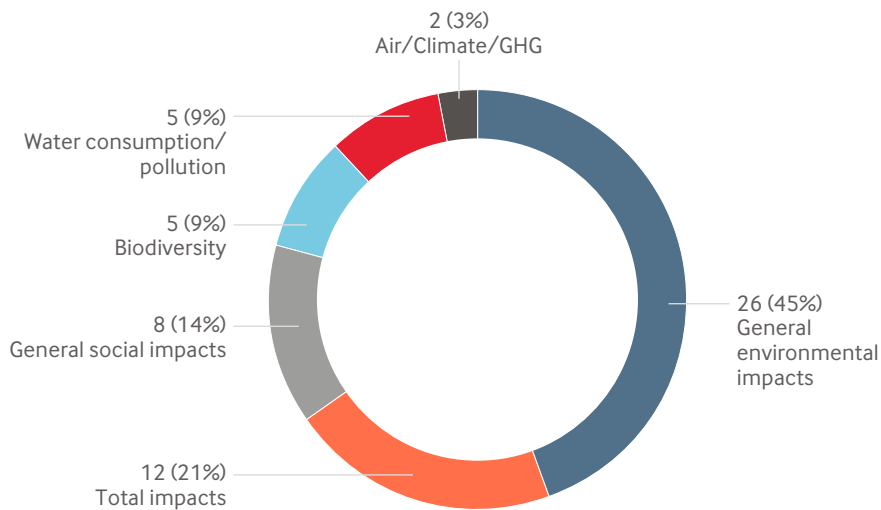
MOST COMMON IMPACT AREAS

Similarly, most of the tools are designed to assess environmental impacts. The categories of impacts utilized in this study are:

- Air/climate/greenhouse gas emissions (GHG)
- Biodiversity
- General environmental impacts (i.e., multiple environmental impacts)
- General social impacts (i.e., multiple social impacts)
- Land
- Total impacts
- Waste
- Water – consumption or pollution

As shown in figure 2, the most common impact type in the tools database is general environmental impacts (26 tools, 45 percent), followed by total impacts (12 tools, 21 percent), general social impacts (eight tools, 14 percent), biodiversity (five tools, 9 percent), water consumption or pollution (five tools, 9 percent) and air, climate or GHG (two tools, 3 percent). Interestingly, we did not identify any tools that only measure the impacts to land or from waste, although both land and waste impacts are assessed by tools that also assess other forms of impacts.

Figure 2. Tools by impact measured

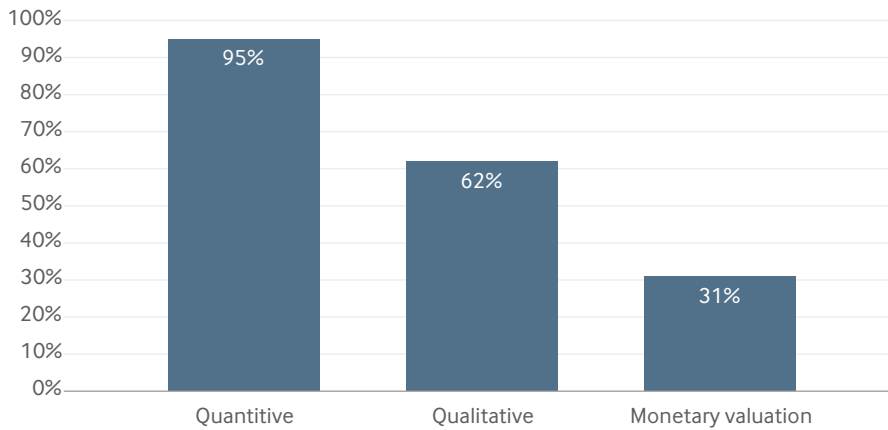


MEASUREMENT OR MONETARY VALUATION

Environmental and social impacts can be recorded as either a quantity or a monetary value.

As shown in figure 3, the majority of tools and methods utilize quantitative (95 percent) and/or qualitative (62 percent) measurement techniques to measure environmental and social impacts. Only 18 tools (31 percent) assign a monetary value to these impacts and, of these, most tools focus on general environmental impacts (11 of 18) or total impacts (5 of 18).

Figure 3. Tools by measurement technique

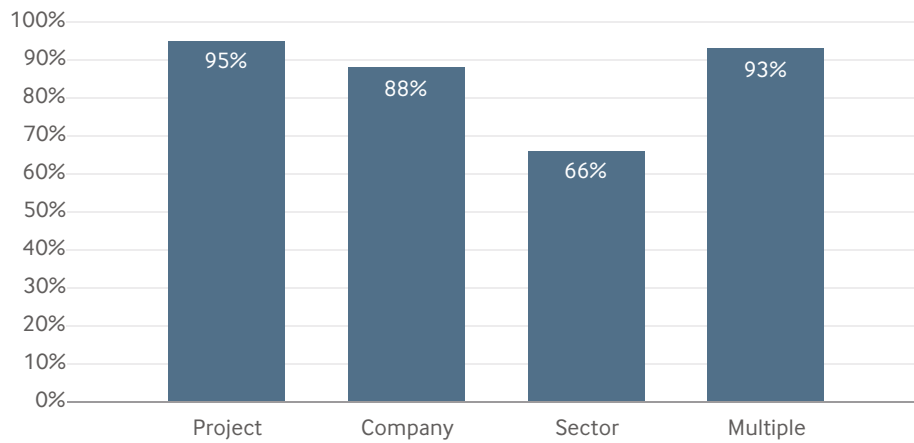


LEVELS OF ANALYSIS

Tools and methods can measure impacts at different “levels of analysis.” Some tools, such as the Integrated Biodiversity Assessment Tool (IBAT), the Water Accounting Framework for the Minerals Industry and SUSOP (Sustainable Operations), focus specifically on positive and negative impacts at the project, site or operational level. Other tools and methods focus on the business operation or company as a whole, such as the Greenhouse Gas Protocol, Social Return on Investment (SROI), the Balanced Scorecard Approach and PwC’s Total Impact Measurement Management. Still other tools and methods focus on the industry or sector as a whole (for example, Environmental Profit and Loss) or the specified product that is being extracted or manufactured (for instance, Integral Biodiversity Impact Assessment System).

Among the tools included in the database, the most common level of analysis is the project, site or business operations (55 tools, 95 percent), followed by the company as a whole (51 tools, 88 percent). Most tools use multiple levels of analysis (54 tools, 93 percent). Some tools look at the sector or industry level (38 tools, 66 percent).

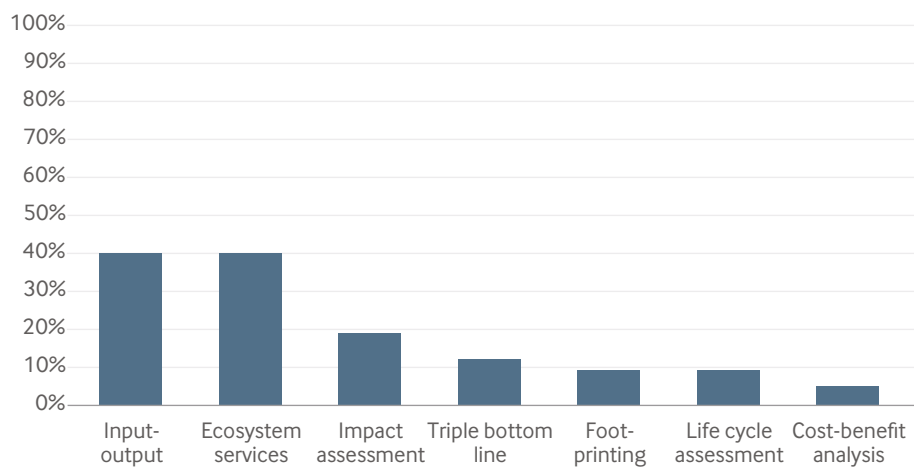
Figure 4. Tools by level of analysis



KEY METHODS

Many tools utilize input-output methods (40 percent) and ecosystem service valuations (40 percent). Some tools also use impact assessment (19 percent), triple bottom line approaches (12 percent), footprinting methods (9 percent) and life cycle assessment (9 percent). A few tools use cost-benefit analysis methods (5 percent).

Figure 5. Tools by key method used



VIII. Guiding principles for measuring environmental and social impacts

Tools and methods notwithstanding, measuring environmental and social impacts cannot contribute to better extractive sector governance if the process of measurement lacks credibility. Inclusive, thorough and transparent measurement processes are crucial to producing valid and useful results. Further, measurement should never be used to negate the right of groups to free, prior and informed consent, where such right applies, and quantification should complement qualitative assessment.

With that being said, the following suggested general principles may serve as a starting point for stakeholders interested in further exploring measurement of environmental and social impacts as a means of enhancing decision-making in the extractive sector. They have particular relevance for any attempts at more holistic, “total impacts” assessments conducted or commissioned by governments.

WHO	<p>Principle 1. Ensure inclusive multi-stakeholder measurement processes that enable meaningful participation of affected communities, with due regard for gender dynamics and the views of minority and marginalized groups. Different people, in different places, will place different values, on different things, at different times. Multi-stakeholder participation—with an inclusive representation of local, regional and national interests, as well women, minority and marginalized groups—is a foundational platform to promote shared understanding of objectives, processes and outcomes of environmental and social impact measurement. In most instances, these multi-stakeholder processes would be government-led.</p>
	<p>Principle 2. Involve interdisciplinary teams from the start. With the input of interdisciplinary teams of environmental scientists, economists, human rights specialists, lawyers, anthropologists, town planners, geologists, engineers, metallurgists and people with other diverse backgrounds, a wide range of data sources can be accessed to improve the validity and reliability of environmental and social impacts measurement and valuation methods, while ensuring legal and customary rights of affected individuals or communities are respected.</p>
WHEN	<p>Principle 3. Begin measurement of environmental and social impacts before extraction and continue through the life of the project and after closure. Modeling can help guide decisions on where extraction may take place and how projects will be regulated. Once projects are approved, measurement should continue over time as impacts shift from the hypothetical to the actual—from things that can be modelled, to things that can be measured. Ongoing measurement allows for adaptation and improvements over time.</p>
WHAT	<p>Principle 4. Identify material impacts across capitals (built, financial, human, natural or social capital), project scenarios, geographic scales and time horizons. Scanning across capitals to identify the potential material impacts of proposed projects or regulations can help ensure that these impacts on particular stakeholders are not overlooked. Multiple project plans, scenarios and regulatory options can be modelled to maximize net value creation and minimize net risk across various capitals. Assessment should be time and space specific, at scales meaningful for policy formation or project evaluation, acknowledging that both ecological functioning and economic values differ according to context and timeframes. It is also important to consider the cumulative impacts that emerge over time and, where possible, across multiple industrial activities and geographies.</p>
	<p>Principle 5. Include in stakeholder dialogue and decision-making frameworks both quantifiable impacts and those that cannot or should not be measured; and consider who bears the costs and benefits of these impacts. Impacts that cannot be quantified should be included in the overall analysis, using qualitative assessment techniques. Further, even where benefits outweigh costs, costs may be concentrated in certain areas or among certain groups. It is therefore crucial to consider both the size and distribution of impacts.</p>
HOW	<p>Principle 6. Ensure measurement approaches are appropriate to the policy question at hand and to the country and local context. Measuring the environmental and social impacts of extraction can be relatively simple or staggeringly complex. Chosen tools and methods should be appropriate to the policy question at hand—opening an area for exploration versus designing a regulation—suited to the human resources available to undertake the measurement and culturally relevant.</p>
	<p>Principle 7. Protect legal and customary rights throughout the measurement process, including free, prior and informed consent where applicable. Measurement must not be used to violate legal and customary rights, including the right to withhold free, prior and informed consent where such right applies.</p>
	<p>Principle 8. Ensure measurement processes and results are transparent, timely and understandable. Most importantly, processes and results of any measurement must be transparent, timely and explained, including tools and methods used, data sources, assumptions and limitations. This allows for confidence in the validity and quality of measurement.</p>

PRINCIPLE 1. ENSURE INCLUSIVE MULTI-STAKEHOLDER MEASUREMENT PROCESSES THAT ENABLE MEANINGFUL PARTICIPATION OF AFFECTED COMMUNITIES, WITH DUE REGARD FOR GENDER DYNAMICS AND THE VIEWS OF MINORITY AND MARGINALIZED GROUPS

Fiscal forecasts and models are based on a wide range of assumptions, such as those relating to commodity prices, foreign exchange rates, final resource reserves, various costs and timeframes. The same is true for environmental and social impacts, except the assumptions that underlie modeling these impacts are arguably more subjective than their fiscal counterparts—different people, in different places, will put different values on different things, at different times.

For instance, one stakeholder group may value financial revenues or jobs over negative impacts to the aesthetic qualities of landscapes, or one ecosystem service such as water (which may be comparatively scarce) over another such as land (which may be comparatively plentiful). These subjective judgments depend largely upon the views and needs of stakeholders and can be particularly challenging when assessing the value of ecosystem services and other capitals that have no market value. In these situations, multi-stakeholder dialogue helps to explore different perspectives and perceptions about values and trade-offs at different scales.

Different people, in different places, will put different values on different things.

Moreover, even if in some areas it is possible to value an impact with great accuracy, that value may not be credible if it is advanced by a single party. Therefore, even if multi-stakeholder dialogue fails to resolve different views on the value or measurement of an impact, it serves as a valuable platform for different parties to understand different methods of measurement.

Further, multi-stakeholder processes can help to ensure a more complete understanding of the distribution of potential or actual costs and benefits among stakeholders. Understanding who is bearing the costs and benefits is crucial for designing effective mitigation and compensation strategies. In this regard, the views of communities who stand to be, or are, directly affected by extractive activities must be central to any effective measurement process. It is also important that women, minorities and other marginalized groups are empowered to meaningfully participate in measurement, valuation and corresponding compensation processes, to ensure these processes do not serve to reinforce or exacerbate power imbalances. Resources such as Oxfam Australia's *A Guide to Gender Impact Assessment* might serve as useful inputs for designing such processes.⁹³

Multi-stakeholder processes will vary across contexts, however, key principles include inclusivity, transparency, rigor and due process.

PRINCIPLE 2. INVOLVE INTERDISCIPLINARY TEAMS FROM THE START

With the input of interdisciplinary teams of environmental scientists, economists, human rights specialists, lawyers, anthropologists, town planners, geologists, engineers, metallurgists and people with other diverse backgrounds, a wide range of data sources can be collected and interpreted to improve the validity and reliability of environmental and social impact measurement and valuation, while ensuring legal and customary rights of affected individuals or communities are respected.

93 Christina Hill, Chris Madden and Nina Collins. *A Guide to Gender Impact Assessment* (Oxfam Australia, 2017), www.oxfam.org.au/wp-content/uploads/2017/04/2017-PA-001-Gender-impact-assessments-in-mining-report_FA_WEB.pdf.

It is common, for example, for extractive projects to be associated with a diverse range of impacts from economic to environmental, social, political, institutional and cultural. When assessments of projects are conducted within limited domains of knowledge (for instance financial and technical), they are necessarily reductionist in their presentation of potential value creation and risks.

Inter-disciplinary teams may also have a better chance of determining attribution; that is, whether a change is the result of factors related to the project.

PRINCIPLE 3. BEGIN MEASUREMENT OF ENVIRONMENTAL AND SOCIAL IMPACTS BEFORE EXTRACTION AND CONTINUE THROUGH THE LIFE OF THE PROJECT AND AFTER CLOSURE

Modeling can help guide government decisions on where extraction may take place and how projects will be regulated. Once projects are approved, measurement should continue over time as impacts shift from the hypothetical to the actual—from things that can be modeled, to things that can be measured. Ongoing measurement allows for adaptation and improvements over time.

More specifically, measurement should follow the extraction project life cycle of pre-feasibility, feasibility, construction, operation, decommissioning and post-closure. As extractive projects progress through these stages, a number of factors will affect the accuracy of initial environmental and social impact estimates.

For example, the assumptions and perceptions that underlie initial environmental and social impact measurements change over time as more information and experience become available. They will also vary as different technologies and techniques become available that allow for greater mitigation at lower costs.

Finally, measurement over time is crucial because, while it is common for costs and benefits to be quantified during the lifetime of a project, inter-generational impacts after the end of a project are less frequently modelled, measured and addressed, even in the economic realm. For example, an extractive resource might sustain a certain level of employment for a certain period of time. These employment benefits are likely to dissipate over time unless the project leaves a legacy of trained and employable human capital, or surplus financial dividends are saved or invested into developing alternative sources of income and wealth.

From things that can be modeled, to things that can be measured.

PRINCIPLE 4. IDENTIFY MATERIAL IMPACTS ACROSS CAPITALS (BUILT, FINANCIAL, HUMAN, NATURAL OR SOCIAL CAPITAL), PROJECT SCENARIOS, GEOGRAPHIC SCALES AND TIME HORIZONS

A multi-stakeholder process of scanning across capitals to identify potential material impacts of proposed projects or regulations can help ensure material impacts on particular stakeholders are not overlooked.

For a range of reasons—chiefly resources and the availability of data—it may not be practical to focus on detailed measurement or forecasts of all impacts across all capitals, even for “total impacts” assessments. When determining which impacts to measure and at what level of detail, countries, companies and communities should scan all forms of capital, and set a materiality criteria for measurement and forecasting of environmental and social impacts.

Materiality criteria may differ across different forms of capital and may need to be either quantitative (for instance, a financial value) or qualitative (for instance, agreement among stakeholders that the impact is significant).

Multiple project plans, scenarios, regulatory options should be modelled to maximize net value creation and minimize net risk across various capitals, including the “null” case of not proceeding with the project--what is the impact of doing nothing or of carrying out a competing but mutually exclusive development? This requires the measurement of existing baseline conditions, as well as projected conditions.

Assessment should be time and space specific, at scales meaningful for policy formation or project evaluation, acknowledging that both ecological functioning and economic values differ according to context and timeframes. It is also important to consider the cumulative impacts that emerge over time and, where possible, across multiple industrial activities and geographies.

What is the impact of doing nothing or of carrying out a competing but mutually exclusive development?

PRINCIPLE 5. INCLUDE IN STAKEHOLDER DIALOGUE AND DECISION-MAKING FRAMEWORKS BOTH QUANTIFIABLE IMPACTS AND THOSE THAT CANNOT OR SHOULD NOT BE MEASURED; AND CONSIDER WHO BEARS THE COSTS AND BENEFITS OF THESE IMPACTS

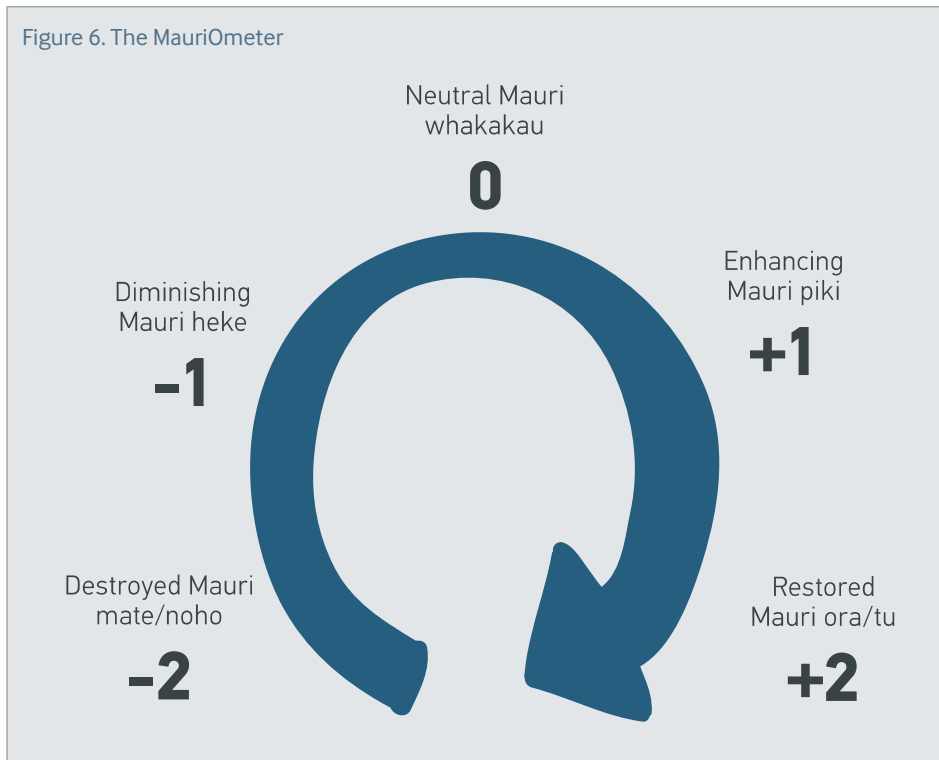
Not all material impacts can be quantified. In some cases, measurement of an impact identified as material can only be made in terms of broadly positive or broadly negative, instead of in money or other units. This does not mean such impacts should be excluded from consideration. Qualitative assessment is important and can still facilitate conversations about how capitals might be enhanced or threatened by extractive activities—or by regulation of those activities—and what mitigation or compensation is appropriate. For example, it may not be acceptable to address a cultural loss with an economic gain, but it may be acceptable to address a cultural loss with a cultural gain—see for instance case study in box 12.

Box 13. The mauriOmeter⁹⁴

The mauriOmeter is a digitized version of the Mauri Model, a decision-making framework developed in New Zealand that draws on indigenous Maori culture. It uses the concept of “mauri,” or wellbeing, as a measure of sustainability, where impacts might not be appropriately represented as a monetary value. The model measures mauri in four dimensions – environmental wellbeing (taiao mauri), cultural wellbeing (hapu mauri), social wellbeing (community mauri) and economic wellbeing (whanau mauri). Indicators are chosen to represent impacts in these four dimensions and impacts upon indicators are measured using the mauriOmeter. For example, the mauriOmeter can be used to show whether a project’s impact on indicators of cultural wellbeing is “mauri mate” (dead, deceased or destroyed). (See figure 7 below.)

At the same time, it might then be possible to place a much more precise and monetized value on ensuring that other cultural indicators shift from being “mauri heke” (falling, descending) to being “mauri ora” (alive, safe, well). That could be by enhancing local knowledge or protecting mahinga kai (food and other resources and the areas from which they are collected). Such a process does not suggest an acceptance of the total loss of something of cultural or spiritual value, but it does accept that indicators of cultural wellbeing can be enhanced as well as threatened.

94 See www.mauriometer.com. The Mauri Model was developed by Kepa Morgan, then faculty member of the University of Auckland and member of the Te Arawa people.



In addition, even where benefits outweigh costs, costs may be concentrated in certain areas or among certain groups. It is therefore crucial to consider both the size and distribution of impacts.

PRINCIPLE 6. ENSURE MEASUREMENT APPROACHES ARE APPROPRIATE TO THE POLICY QUESTION AT HAND AND TO THE COUNTRY AND LOCAL CONTEXT

Measuring the environmental and social impacts of extraction can be relatively simple or staggeringly complex. Chosen tools and methods should be appropriate to the policy question at hand—opening an area for exploration versus designing a regulation—suited to the human resources available to undertake the measurement and culturally relevant. Especially when it comes to impacts to culture or heritage, consultative processes that are grounded in or informed by the culture of directly-affected communities would be necessary to achieve genuine dialogue.

PRINCIPLE 7. PROTECT LEGAL AND CUSTOMARY RIGHTS THROUGHOUT THE MEASUREMENT PROCESS, INCLUDING FREE, PRIOR AND INFORMED CONSENT WHERE APPLICABLE

Measurement must not be used to violate legal and customary rights, including the right to withhold free, prior and informed consent, where such right applies. Protection of this right should include consent to the measurement process itself. However, measurement could help inform the decisions around the exercise of such rights, as appropriate.

Measurement must not be used to violate legal and customary rights.

There are often strong incentives on the part of both companies and executive governments to proceed with extraction. In this regard, oversight and appeal processes are indispensable to ensure rights holders have recourse in cases of violations.

PRINCIPLE 8. ENSURE MEASUREMENT PROCESSES AND RESULTS ARE TRANSPARENT, TIMELY AND UNDERSTANDABLE

Most importantly, processes and results of any measurement must be transparent and explained, including tools and methods used, data sources, assumptions and limitations. It may be appropriate to use graphics, charts or other visual representations to simplify measurement processes and results to non-technical audiences. This allows for confidence in the validity and quality of measurement.

Conclusion

The extractive sector can generate substantial revenues. But oil, gas and mining projects also generate a range of other positive and negative impacts to communities and ecosystems. Effective decision-making in extractive sector governance requires a departure from the current disproportionate emphasis on fiscal revenues, to a more integrated approach that considers the broader costs and benefits of extractive projects and the regulations governing them. While extractive sector revenues are commonly modelled, tracked and reported, the environmental and social impacts of extraction are less consistently modelled, measured and reported in quantified terms. And these impacts are not often integrated into the analysis of the expected or actual economic contribution of extractive projects.

There are many ways to describe and monitor environmental and social impacts. Qualitative assessment, investigative reporting and activism remain invaluable tools for ensuring these impacts receive due attention. When used alongside these qualitative approaches, measurement can help all stakeholders better understand the nature, scope and distribution of these impacts, and track how they are varying over time or in response to regulatory interventions. Monetary valuation can further highlight the economic impact of decisions on extractive sector management and help clarify the trade-offs.

Not all impacts can or should be quantified, and policy decisions should not be made solely on the basis of a simple quantified cost-benefit analysis. However, measurement, modeling and monetary valuation can help broaden the language used to discuss the impacts of extractive activities and provide greater common ground upon which to understand and compare sometimes competing options.

As technology leads to new discoveries and makes extraction possible in frontier geographies, it is perhaps more important than ever to ensure we move beyond just revenues to count the broader costs and benefits of our decisions.

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