

Business for Social Responsibility

Measuring Corporate Impact on Ecosystems: A Comprehensive Review of New Tools

Synthesis Report

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With support from BSR's Environmental Services,
Tools and Markets Corporate Working Group

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1. Introduction

One hundred years ago, we didn't have the dozens of macroeconomic measures in use today. The SEC didn't exist, nor did reporting requirements for investors. The Great Depression presented circumstances that couldn't be addressed without new tools and metrics. Today is an equivalent era for environmental issues.

– David Batker, Earth Economics Institute, 2008

An array of processes already exists for environmental data gathering, stakeholder engagement and decision making. Within these approaches, many companies have established processes for navigating a wide range of differences in stakeholder views and values across a range of issues, including values associated with natural resources.

Within the past couple of years, however, key stakeholders and opinion leaders have expanded their focus to include consideration of new, often harder to measure issues, such as ecosystem services. The reason is simple. It is increasingly clear that many of these current corporate environmental performance measures fail to capture impacts on broader ecological dynamics.

For companies, this emerging expansion of corporate environmental performance expectations could be significant. Companies may face accountability, not only for pollution prevention, but also for impacts (positive or negative) to ecological structure and function in the areas where they operate or source. Such an evolving mandate could either be advanced via regulation or, more opaquely, become expected practice by investors, insurers, activists, employees or neighboring communities. Such an expanded focus would translate into a company needing to understand its dependencies and impacts (both positive and negative) on the flow of ecosystem services.

There are growing sets of drivers for businesses to restore the function of ecological systems, some of which are listed below.

1. New ways for businesses to:

- Create value
- Consider risk mitigation
- Differentiate among competitors
- Realize new revenue streams through ecosystem services protection
- Access capital and new markets
- Save on costs

2. New mindsets on the part of regulators and key stakeholders that prioritize holistic ecosystem approaches over siloed management of air, freshwater, biodiversity, etc.

3. New market valuation techniques as trendsetters incorporate ecosystem services into their research

4. New criteria for project finance and credit, as financiers signal that some environmental assets (e.g. IUCN protected areas I–IV) are priceless

Illustrative Ecosystem Services:

- Purification of air and water
- Regulation of water flow
- Detoxification and decomposition of wastes
- Generation and renewal of soil and soil fertility
- Pollination of crops and natural vegetation
- Control of agricultural pests
- Dispersal of seeds and translocation of nutrients
- Maintenance of biodiversity
- Partial climatic stabilization
- Moderation of temperature extremes
- Wind breaks
- Support for diverse human cultures
- Aesthetic beauty and landscape enrichment

Source: Daily, Gretchen. 1997. Nature's Services. Washington, D.C., USA: Island Press.

Yet many in the private sector may ask why should a business — which already pays to meet air and water pollution regulations and other guidelines, as well as to gain services from a local or regional water utility — suddenly start paying for ecosystem services? More pointedly, why would individual businesses pay for the maintenance of well-functioning ecosystems when everyone relies upon them?

The first answer revolves around risk mitigation. In an environment of unpredictable weather, shifting rainfall, water shortages and clean technology, the most nimble and risk-aware companies are those that will excel. The possibilities for corporate restoration of private lands, as a risk mitigation strategy, are intriguing — particularly if these are occurring within the context of emergent public policy, in which a company can demonstrate leadership and thus, in part, shape.

The second answer is that policymakers are beginning to incorporate ecosystem services principles into policy dialogues and new legislation. Today, ecological investment vehicles are proliferating in the form of carbon markets, self-organized watershed restoration deals and biodiversity impact offsets. A mix of regulatory and voluntary markets now trade at multibillion-dollar levels in environmental derivatives of carbon sequestration, water-quality improvements and biodiversity conservation. In addition, companies that rely upon particular ecosystem services are engaging in focused business deals and payments for ecosystem services (PES) at local levels.

The third answer is that companies today could position themselves for winning new business, investors and regulatory goodwill within this shifting environmental context. Integration of ecosystem service-related parameters within existing approaches may well become a key element to such positioning for market leadership. (For more detail on emerging elements of the business case, see BSR's "Executive Briefing on Environmental Markets.")

The next section provides an overview of key tool design considerations for a business audience and it underscores the importance of integrating new environmental parameters within corporate decision-making protocols. The report then offers a comparative analysis of the tools for potential users, with an emphasis on corporate decision makers.

11. Building the Business Case for Ecosystem Services Tool Use

As the environmental management paradigm shifts to one of ecosystem services, the question for corporate decision makers becomes when to add new parameters to existing protocols and how to integrate new components. (For an introduction to ecosystem services as the concepts apply to business management, see BSR's "The New Markets for Environmental Services: A Corporate Manager's Resource Guide to Trading in Air, Climate, Water and Biodiversity Assets.")

In addition, many companies will need to consider the rigor, feasibility and cost associated with assessing new environmental factors, particularly: 1) within contexts where few experts exist and data is sparse, as is currently the case for most operating regions and 2) as the information technology platforms evolve to become more data-rich and user-friendly. Within this context, companies can begin to ask "if, when and how" they would utilize emerging tools for ecosystem services assessment and management.

"If":

- Are market or operating conditions making ecosystem-level assessments critical to my company?
- How comfortable is senior management with piloting assessment tools when no clear standardized guidelines exist?
- What investments would my company make in data collection versus collaborating with NGO or academic partners on the ground?

"When":

- What are the trends projected for the market or operating conditions mentioned above?
- Can the case be made to management that positioning our company now will benefit it once the field crystallizes?

A. "The How": Integrating New Assessment Protocols into Corporate Processes

Once a company has satisfactorily answered the "if" and "when" questions above, decisions must be made about *how* to move forward with ecosystem services assessment.

1. Gap Analysis for Processes: A logical first step is to conduct a gap analysis of existing internal processes and reporting tools (e.g. Environmental Impact Assessment, Biodiversity Action Plan, etc.) to gauge their effectiveness in identifying ecosystem service-related issues. In some cases, existing reporting protocols, some driven by voluntary or regulatory government programs, may act as barriers to a shift toward ecosystem services-level management.

2. Gap Analysis for Expertise: As with any cutting-edge domain, the necessary skills may not exist in-house, and early conversations with academic, NGO or consultant advisors will benefit eventual decision making.

3. Cultural Litmus Test: It will be useful to gauge past success in measuring historically intangible values. If the company culture is not conducive, it may be worth prioritizing tools that place a value on ecosystem services, rather than those that are more qualitative or relative in their results.

4. Wish List of Tool Attributes: Based upon findings from the above steps, one can assemble a "wish list" of tool design attributes that would be most helpful to a company's decision-making circumstances. On the next page is the "wish list" from companies in our working group.

Figure 1: A Corporate “Wish List” of Ideal Tool Attributes

-
- MODEL**
- a. Utilize recognized nomenclature for ecosystem services, such as the Millennium Ecosystem Assessment, and justify any adaptations made.
 - b. Volunteer up front information on data gaps and the subsequent limitations of the tool for any given region.
 - c. Demonstrate wide recognition among stakeholders that the methodologies and assumptions are transparent, reliable and accurate.
 - d. Design for modular and continual updating of the tool to ensure that results improve as data layers increase. Plan a business model that will support this regular refresh and maintenance.
 - e. Allow for “tagging” of preloaded versus user-loaded data, so that users can parse out the source (i.e. preloaded, government, corporate, etc.) at a later date.
 - f. Consider “co-branding” outputs with credible NGO or government partners to enable corporate users to point to these brands when making the case for tool use.
 - g. Make tool adaptable to different industries, some of which have significant and direct land impacts while others are only indirect users.
-
- INPUTS**
- a. State up front the following specifications:
 - The ideal format and form of data to be input (with guidance on how to convert to this form)
 - The ideal geographic scale at which the tool should be applied
 - The sources and collective methodologies underpinning any preloaded datasets
 - The estimated financial and human resources for quality outputs
 - Any third-party assurances for the tool’s methodology
 - What users can do to reduce the level of uncertainty of the tool’s results
 - b. Be flexible enough to incorporate both expert and community input, especially as it relates to relative values for specific ecosystem services.
 - c. Offer a “do-it-yourself” approach that allows corporate decision makers to leverage pre-existing environmental data collection and decision-making processes and protocols.
-
- OUTPUTS**
- a. Characterize the level of uncertainty for any given output, based upon the quality of the data as well as the scientific consensus around dynamics in the ecosystem of interest. Probabilistic models are most easily understood among corporate audiences.
 - b. Offer functionality for identifying cumulative impacts and reinforcing drivers from all activities in a given region and flagging potential ecological tipping points.
 - c. Where feasible, include a sensitivity analysis to demonstrate the system-wide consequences of possible activities.
 - d. Offer results at varying geographic scales to enable flexibility across corporate and project planning.
 - e. If reporting valuation results, provide them in relative, nonmonetary units, not absolute financial equivalents, and include a range of stakeholder values, accounting for differing economic and cultural circumstances.
 - f. Alongside results, provide anecdotal cases from past benefits accruing to companies that protected a similar ecosystem service.
 - g. Where feasible, provide an overlay of markets and/or transactions in the region of interest, including real-time pricing.
-
- COST**
- a. Minimize resource demands for basic tool use to make initial adoption more likely.
 - b. Consider offering tiered levels of access and/or complexity of results.

5. Match Selected Tools to Existing Decision-Making Points: Prospective users will need to clarify the “interface points” between tools and relevant business decision-making points, including the following:

- **Product and process design decisions**, including optimization along the extended value chain
- **Facility design and site location decisions**, related to project investments and project stage reviews
- **Innovation opportunity areas**, including strategic R&D initiatives and highest value efforts
- **Corporate performance targets**, including local and regional targets/metrics
- **Stewardship and communication strategies**, such as corporate social responsibility (CSR)
- **Tradeoffs assessments**, such as net environmental benefit evaluations
- **Sustainability strategy justifications** and building the business case for sustainability/CSR

6. Decide on Balance of In-House Versus Outsourced Work: Corporate practitioners have pointed to the fact that major companies tend to trust models built in-house or at least with their own datasets. As such, prospective tool users will need to strike a balance between drawing on the deep expertise of external tool developers while maximizing in-house modeling capacity and know-how.

7. Use Tool as Shared Analytical Platform for Cross-Enterprise Dialogue: One of the more intangible benefits of tool adoption will be the opportunity to discuss ecosystem services issues across the company. Through the data collection process, tool users will gain a better understanding of the day-to-day challenges in each business unit, and build relationships that can lead to better environmental decision making in the future.

By taking these steps, it is possible for companies to optimize their use of emerging tools and in so doing, to integrate key questions about dependencies and impacts on ecosystems, as well as facilitate alignment between corporate environmental strategy and regionally specific policies.

III. The Current Ecosystem Services Tools “Landscape”

These growing efforts around environmental markets, PES and other policy changes to include ecosystem services imply that companies will need to understand their dependencies and impacts on ecosystem services. In response, over the past few years, academics, nongovernmental organizations (NGOs) and public sector research entities have been quietly developing tools to enable key decision makers — in public, private and nonprofit sectors — to integrate ecosystem service concepts into planning as well as daily operations. The growing number of initiatives can make it challenging to sort out which tools are applicable at which decision-making juncture, which rely on robust analytical methods and high quality data, and which may be used in concert with other decision-making tools.

A. Multi-Ecosystem Service Assessment Tools

There is now a set of emergent tools for conducting multiple ecosystem service-focused assessments, including:

- ARIES (ARtificial Intelligence for Ecosystem Services) by the University of Vermont’s Ecoinformatics “Collaboratory” (at the Gund Institute for Ecological Economics), Conservation International, Earth Economics, and experts at Wageningen University
- ESR (Ecosystem Services Review) by the World Resources Institute (WRI), the Meridian Institute, and the World Business Council for Sustainable Development (WBCSD)
- InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) by The Natural Capital Project, a joint venture among Stanford University’s Woods Institute for the Environment, The Nature Conservancy and World Wildlife Fund (WWF)
- MIMES (Multi-scale Integrated Models of Ecosystem Services) by the University of Vermont’s Gund Institute for Ecological Economics
- NVI (Natural Value Initiative) Toolkit by Fauna & Flora International, Brazilian business school FGV, and the United Nations Environment Programme Finance Initiative

B. Biodiversity-Focused Tools Linked to Ecosystem Services

In addition to these tools focused on multiple ecosystem services, a number of other tools exist — or are in development — that are also relevant given: a) the role of biodiversity in ecosystem structure and function and b) the broader range of environmental parameters being considered, which include elements of ecosystem services. These other relevant assessment approaches, which are in various stages of development, include:

- BBOP (Business and Biodiversity Offsets Program) Toolkit by Forest Trends, Conservation International and the Wildlife Conservation Society
- IBAT (Integrated Biodiversity Assessment Tool) by Conservation International, BirdLife International and the UN Environment Programme’s World Conservation Monitoring Centre

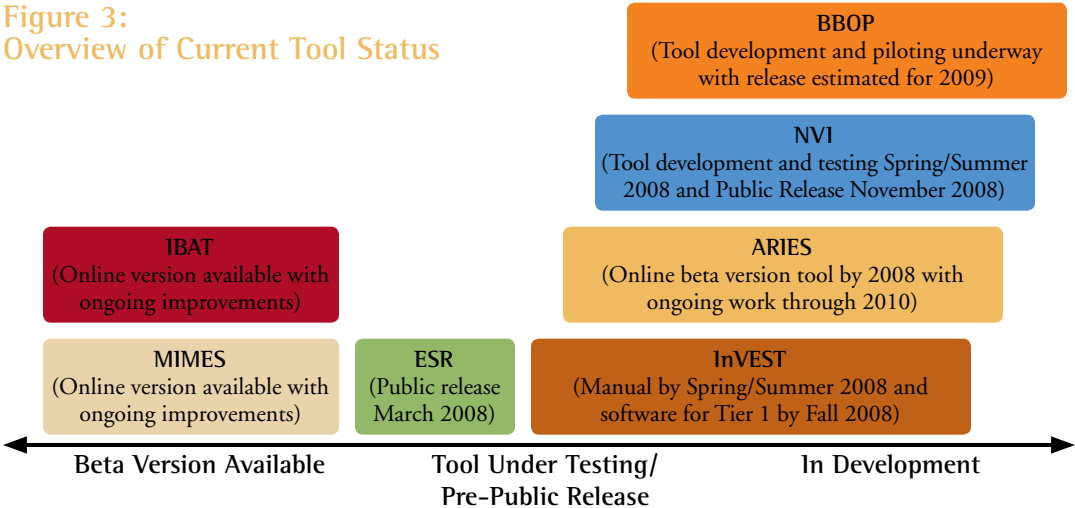
Figure 2: Overview of Ecosystem Service Assessment Tools

	Description	Intended Users	Salient Features
Multi-Ecosystem Service Assessment Tools			
ARIES	A computer model and decision-support infrastructure to assist decision makers and researchers by estimating and forecasting ecosystem services provision and their correspondent range of economic values in a specific area	<ul style="list-style-type: none"> ■ Policymakers ■ NGOs ■ Consultants ■ Companies 	<ul style="list-style-type: none"> ■ Probabilistic, nondeterministic model designed for continual updating ■ Transparent, so users know information sources ■ User-friendly interface despite complexity of model ■ Builds on University of Vermont’s Ecosystem Services Database, which contains spatially-explicit, peer-reviewed valuation data as well as methods of analysis, publications and project models ■ Will be pilot tested via Conservation International and Earth Economics
ESR	A sequence of questions that helps managers develop strategies to manage risks and opportunities arising from a company’s dependence on ecosystems	<ul style="list-style-type: none"> ■ Corporate managers 	<ul style="list-style-type: none"> ■ Offers a methodical, logical sequence of guiding questions ■ Most advanced in terms of “road-testing” with companies ■ Plans to provide guidance on integration into existing Environmental Management Systems as well as valuation techniques
InVEST	A decision-making aid to assess how distinct scenarios may lead to different ecosystem services and human-well-being-related outcomes in particular geographic areas	<ul style="list-style-type: none"> ■ Government agencies ■ Farmers and individual landowners 	<ul style="list-style-type: none"> ■ Enables users to input their own site-specific data ■ Allows for expert opinion as data to address data gaps ■ Enables consideration of present and future tradeoffs from alternative resource management ■ User-friendly with few data requirements ■ Identifies where ecosystem service benefits originate
MIMES	A multi-scale, integrated suite of models that assess the true value of ecosystem services, their linkages to human welfare, and how their function and value may change under various management scenarios	<ul style="list-style-type: none"> ■ Scientists ■ Policymakers ■ Natural resource managers 	<ul style="list-style-type: none"> ■ Value can be denominated in monetary terms, land area or other parameters ■ Is already populated with reliable, publicly available data ■ Can be scaled for additional data input ■ Model is open source and has been successfully implemented
NVI	An evaluation benchmark methodology for assessing biodiversity and ecosystem services-related risks and opportunities in the food, beverage and tobacco sectors	<ul style="list-style-type: none"> ■ Corporate managers ■ Financial analysts 	<ul style="list-style-type: none"> ■ Promotes greater awareness within the finance sector of the links between biodiversity, ecosystem services and investment value, including the risks associated with mismanagement ■ Creates a company risk profile and offers case studies based on both publicly available information and direct corporate engagement
Biodiversity-Focused Tools Linked to Ecosystem Services			
BBOP	A toolkit that assesses whether biodiversity offsets are appropriate and provides guidance on offset design	<ul style="list-style-type: none"> ■ Corporate managers 	<ul style="list-style-type: none"> ■ Offers biological and socioeconomic indicators to show net gain or loss of biodiversity ■ Designed to eventually sync with Environmental Impact Assessments (EIAs) ■ Codedigned by corporate, government and conservation organizations
IBAT	A screening tool to help companies incorporate biodiversity into their risk analysis, decision-making and planning processes	<ul style="list-style-type: none"> ■ Corporate managers 	<ul style="list-style-type: none"> ■ Builds on locally collected scientific knowledge and data ■ Delivers a cost-effective product in a timely manner ■ Limited to biodiversity “hot spots” and protected areas ■ Designed to eventually inform Biodiversity Action Plans and EIAs

C. Status of Tool Development

Within the set of tools considered on the preceding page, none are yet fully mature with a robust track record of applications. Rather, the tools sit along a spectrum from “beta” to “prerelease” to “in development.” Most of the tool developers will have made public at least a draft form by the end of 2008.

Figure 3:
Overview of Current Tool Status



IV. Which to Use When? Navigating the Tools “Landscape”

A. Similarities

A range of crosscutting characteristics emerged in this tool review, including:

- 1. Intent** – All of the tools profiled on the preceding pages seek to enable improved decision making through inclusion of ecosystem services considerations.
- 2. Common Target Audience** – All of the tools are intended to influence policymakers, with ARIES, InVEST and MIMES explicitly focused on this target audience. ESR, NVI, IBAT and BBOP have cast a wider net with an emphasis on corporate decision makers.
- 3. Nomenclature** – Most of the tools use the Millennium Ecosystem Assessment set of ecosystem services and definitions. InVEST has narrowed the list to those services it deems as “proxies” for others in an effort to make the set of services more manageable.
- 4. Terrestrial Focus** – None of the tools have fully developed marine/ocean models and few have marine ecosystems as a primary focus area. Marine systems are, however, on the list of future activities.
- 5. Scalable Data and Resource and Time Demands** – ARIES, MIMES, InVEST and IBAT provide preloaded databases while ESR, BBOP and NVI require users to input their own data.
- 6. User Friendly** – The tools are focused on ease of use, either through computer models (in beta versions of MIMES and IBAT, and in yet-to-be-developed software for ARIES and InVEST), or a series of tasks within an overall analytical approach (ESR, BBOP and NVI).
- 7. Credibility** – The involvement of well-respected players in development of these tools is likely to result in higher levels of attention paid by policymakers and other target audiences.
- 8. Unclear Delivery Mechanisms** – While ESR, IBAT, NVI and BBOP are (or will be) available in basic form via the Web, the model-based tools (InVEST, ARIES and MIMES) will require more sophisticated technological delivery. InVEST is working to insert the tool as a feature on ArcGIS.
- 9. Evolving Business and Training Models** – All tool development teams intend to have free public access to at least a basic version of the tool, while MIMES, IBAT and InVEST are considering a paid subscription service for advanced users. All developers are considering ways to provide training to prospective users, rather than become involved in each application of a tool. Such training is also seen as a way to ensure continued quality of results.
- 10. Minimal Stakeholder Engagement Thus Far** – While InVEST and ESR are designed to incorporate stakeholder input as a key source of data during tool use, only minimal stakeholder engagement has been undertaken in tool development across all seven tools. This is due to a combination of the scarce resources and budgets as well as preexisting silos in academic departments, NGOs and other sectors.

B. Distinctions

Despite some areas of resonance across tools, there are a number of key distinctions:

- 1. User Interfaces** – which span from computer models through “workbook-like” Excel spreadsheets.
- 2. Types of Results** – ranging from a list of priority ecosystems to consider through spatially-explicit maps showing changes under different land management scenarios
- 3. Data Demands** – from high to low, spanning from do-it-yourself to detailed preloaded databases.
- 4. Ecological Detail** – from high-level, coarse-grain assessments to fine-grain, map-based assessments

5. Valuation Emphasis – which can be further parsed in terms of value within an existing environmental market (such as within the European Union Emissions Trading Scheme) or value within a broader societal context that draws upon ecological economics theory/concepts.

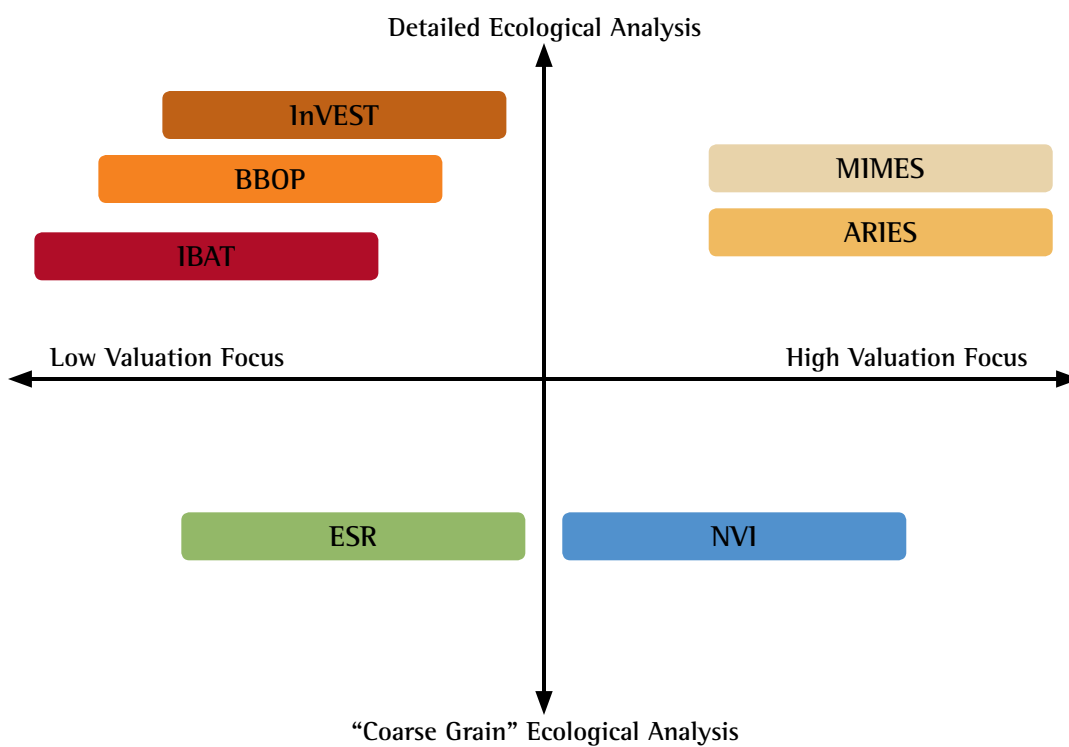
In order to explore further the distinctions outlined on the preceding page, we offer the following illustrative maps that characterize each tool, relative to its peers, across the five distinguishing criteria. Of the tools profiled here, four offer a computer model interface that provides spatially explicit maps as outputs. Foundational to these tools are preloaded databases built from “best-in-class” publicly available information. The other three tools offer sets of questions or a workbook that brings analytical structure to one’s planning.

Figure 4: Map of Tools Based on User Interface, Types of Results and Data Demands

User Interface	Types of Results	Tools (in order of data demands)
Computer Model	Spatially explicit maps	InVEST (Tiers 2 and 3)
		MIMES
		ARIES
		InVEST (Tier 1)
		IBAT
Set of Structured Questions and/or Workbook	Risk and/or opportunities analysis	NVI
		ESR
		BBOP

Those advocating for a shift toward ecosystem services-based management have often called for an emphasis on valuation, or the ability to place financial value on a given service, and possibly even a suite of services known as a “bundle.” However, distinct differences are apparent between European policy dialogues that emphasize valuation and U.S. dialogues that skirt the issue or take a risk mitigation angle. Of the tools assessed here, three have strong focus on valuation as part of their offerings (given NVT’s target audience of financial institutions, this is perhaps not surprising). The majority of tools are also capable of detailed ecological analysis. Depending upon the level of detail needed by the user, as well as the desire to see valuation analysis, the choice of the most appropriate tools quickly becomes clear.

Figure 5: Map of Tools Based on Ecological Detail Versus Valuation Emphasis



It is noteworthy that at present, there are no tools specifically tailored for easy “plug and play” within business decision-making processes. Rather, each of the existing tools could be applied in various ways and during discrete phases of decision making. As the tools evolve, we aim to map each of them to preexisting corporate decision-making processes. In the meantime, one can make the following broad generalizations about when to use which tool.

Figure 6: Map of Tools Based Upon Type of Business Need and Level of Intended Application

Business Need	Corporate Level	Site Level
Basic Risk Screening	ESR	IBAT
	NVI	InVEST (Tier 1)
Scenario Planning and Sensitivity Analysis	MIMES	InVEST (Tiers 2 and 3)
Investment Prioritization	ARIES	BBOP

Based upon the status of each tool as of mid-2008, BSR’s corporate working group participants offered the following perspectives on the relative strengths and weaknesses of each tool for the business world.

Figure 7. Corporate Perspectives on Tools' Relative Strengths and Weaknesses

	Relative Strengths from Corporate Perspective	Relative Weaknesses from Corporate Perspective
ARIES	<ul style="list-style-type: none"> + Ability to utilize without complete data using probabilistic model + Potential for generating discussions through embedded stakeholder engagement process + Flexibility for building as simple or complex a model as is needed by user + Potential to apply in risk assessment process + Ability to compare scenarios and potential ripple effects + Depiction of bundled ecosystem services on spatial map outputs 	<ul style="list-style-type: none"> - Risk of overlooking importance of nonmonetary values - Lack of “off the shelf” model - Need for additional transparency around methodologies (e.g. is data time weighted or flow weighted?) - Need for long-term funding and maintenance plan for both the tool and database - Need for more input from industry, NGO and public sector
BBOP	<ul style="list-style-type: none"> + Conductiveness to integration with impact mitigation planning + Utility for benchmarking potential sites internationally + Proactiveness in driving consensus for international standard 	<ul style="list-style-type: none"> - Minimal utility for companies without “no net loss” biodiversity policies - Persistent concerns around verification of “additionality” - Narrow set of pilot studies
ESR	<ul style="list-style-type: none"> + Potential adaptability to corporate, project and supply chain level + Presence of user guidance on data source needs + Use of business terminology and promotion of business case + Potential for generating discussions through embedded stakeholder engagement process 	<ul style="list-style-type: none"> - Lack of “value-add” for companies beyond the beginner level - Labor and cost-intensiveness as function of designed reliance on expert stakeholder outreach - Failure to address data availability and/or quality issues - Risks overemphasis on provisioning services rather than the supporting and regulating services underpinning them - Failure to incorporate quantification or valuation methodologies
IBAT	<ul style="list-style-type: none"> + Immediate application potential as Web-based, user-friendly screening tool + Transparency of data quality and maturity + Ability to flag regions of overlapping priorities by different groups 	<ul style="list-style-type: none"> - Biases results toward international conservation community priorities, over and above locally valued ecosystems or non-classified regions - Limited to areas of high biodiversity, and therefore inapplicable to majority of industrial operations - Need for long-term funding and maintenance plan for both the tool and database
InVEST	<ul style="list-style-type: none"> + Use of tiers, allowing multiple levels of sophistication, data availability, and emphasis on valuation + Integration with ArcGIS + Strength and track record of partner organizations on this subject + Depiction of bundled ecosystem services on spatial map outputs 	<ul style="list-style-type: none"> - Risk of misleading users due to assumptions about which ecosystem services to exclude - Low relevance of existing pilot applications for business - Lack of clarity on how relative valuation units are calculated
MIMES	<ul style="list-style-type: none"> + Likely receptivity by corporate technical staff + Strength in analyzing potential and/or likely ripple effects across a given system + Ability to utilize significant levels of data to assess microscale decision making (e.g. project level) 	<ul style="list-style-type: none"> - Risk of propagating uncertainty or opaqueness throughout results by layering and linking too many deterministic models (i.e. “black box”) - Limitations for frequency of use due to reliance on data availability - Lack of embedded stakeholder input process - Need for long-term funding and maintenance plan for both the tool and database - Need for more input from industry, NGO and public sector
NVI	<ul style="list-style-type: none"> + Utility and familiarity of third-party benchmarking for corporate users + Ability to stimulate and frame intracompany dialogue + Applicability for screening investment decisions 	<ul style="list-style-type: none"> - Limitations of “checklist” approach for assessing corporate leadership - Lower applicability to non-vertically integrated industries - Questionable ability to stay ahead of and promote new performance standards beyond initial awareness-raising

V. Conclusions and Recommended Pathways Forward

At present the value of these tools is to enable a structured conversation around whether we're asking all the questions that need to be asked and whether we are missing anything we should be thinking about.

– Environmental Services, Tools and Markets Corporate Working Group member, 2008

There remains a considerable amount of work to advance both the business case for, and business adoption of, ecosystem services tools. In order to avoid duplication of effort — or proliferation and dilution of impact — we have attempted to stimulate more coordination between tool developers. Since we launched these efforts, the following progress has been made:

- All seven tool development teams now know of one another's tools and their capabilities
- InVEST's partner organizations have:
 - Approached ArcGIS for delivery of InVEST software
 - Hired a team to design their commercialization strategy and conduct a market-sizing exercise of potential business users
- ARIES and ESR's developers have discussed the complementary nature of their tools and are considering collaboration
- MIMES, ARIES and IBAT developers have explored their respective business models for self-sustained financing and user membership
- All seven tool development teams and working group companies have agreed to host a second three-day workshop in early 2009 to address the proposed pathways forward (see figure below)
- The tool developers have tentatively committed to joint development of a navigational device for prospective users (below)

Figure 8. Possible Taxonomy for Proposed Navigational Device to Tools

Target User	Policymakers	Corporate	Academic/NGO
User Motivation	<ul style="list-style-type: none"> ■ New policy design or elimination of subsidies ■ Regulatory enforcement ■ Mapping of new protected areas ■ Education ■ Seeding of new environmental markets 	<ul style="list-style-type: none"> ■ Risk mapping for ecosystem decline ■ Strategy and policy design ■ Location screening ■ Footprint measurement ■ Liability transfer ■ New revenue-generating transactions ■ Social license-to-operate 	<ul style="list-style-type: none"> ■ Advancement of conservation science techniques ■ Recommendations for protected areas delineation ■ Integration of datasets with other organizations
Desired Outputs	<ul style="list-style-type: none"> ■ Spatially-explicit maps ■ Valuation analysis ■ Return on investment prediction ■ Sensitivity analysis results for scenario planning 	<ul style="list-style-type: none"> ■ Spatially-explicit maps ■ Valuation analysis ■ Return on investment prediction ■ Sensitivity analysis results for scenario planning 	<ul style="list-style-type: none"> ■ Spatially-explicit maps ■ Valuation analysis ■ Return on investment prediction ■ Sensitivity analysis results for scenario planning
Primary Ecosystem Services of Interest	<ul style="list-style-type: none"> ■ Supporting services (select from Millennium Ecosystem Assessment) ■ Provisioning services ■ Regulating services ■ Cultural services 	<ul style="list-style-type: none"> ■ Regulating services ■ Cultural services 	<ul style="list-style-type: none"> ■ Supporting services (select from Millennium Ecosystem Assessment) ■ Provisioning services ■ Regulating services ■ Cultural services
Quality of Input Data	<ul style="list-style-type: none"> ■ High quality ■ Medium quality ■ Low quality 	<ul style="list-style-type: none"> ■ High quality ■ Medium quality ■ Low quality 	<ul style="list-style-type: none"> ■ High quality ■ Medium quality ■ Low quality

Recommended Suite of Tools: X, Y, Z

- Recommended point of application
- Recommended roles and responsibilities

Through our discussion across business, nonprofit, academic and public sector organizations, we discovered the following sets of needs for immediate consideration:

Figure 9. Identified Needs to Advance Tool Development and Uptake

Corporate Users' Needs	Tool Developers' Needs	Public Sector Needs
a. A detailed navigational device to help users find the most suitable tool, or complementary set of tools, for a given decision-making context, including product design and manufacturing	a. A detailed list of corporate decision-making junctures in which an ecosystem services assessment tool could be applied	a. An R&D agenda within regulatory agencies that advances ecosystem services-based management
b. Clarifications on the geographical gaps or data-related biases within the tools	b. A comprehensive list of corporate reporting requirements (internal and external) that could be integrated with ecosystem service assessment tools	b. A prospectus to share with legislators for funding of trans-disciplinary, public-private centers of excellence in regions of high ecosystem service importance
c. Research on the best way to factor ecosystem services issues into capital decision making	c. Input on how to structure and deliver a navigational device to tools	c. An indication from industry and tool developer groups as to how government can constructively engage with their efforts
d. Pilot testing of tools in a public-private partnership within a data-rich region to “kick the tires” for senior management	d. A candid assessment of how seriously, and in what way, industry wants to help advance ecosystem services-based management	

It is our hope that this synthesis paper will be a first step in moving toward greater clarity on the details related to each of the emerging ecosystem service-related tools as well as how to most effectively use the tools within the business setting.