Incorporating Co-benefits and Environmental Data into Corporate Decision-Making

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This case study deals with The Dow Chemical Company's (Dow) decision on how to restore a greenbelt area with historical issue that borders a brownfield property owned by the city of Midland, Michigan. Dow has a stated goal to apply a "business-decision process that values nature" and to deliver $1 billion in "value through projects that are good for business and good for ecosystems." In line with this goal, Dow wanted to restore the greenbelt area by enhancing habitat and ecosystem services to Dow and Midland in a way that was also beneficial to the company's bottom line. This case study presents three alternative restoration designs along with detailed financial cost and environmental data for each design. Students perform cost-benefit analysis, highlighting potential differences between how costs are calculated in a public setting relative to a private setting. In addition, students assess how the inclusion of important non-financial environmental data may be used to inform decision making.

Key words: Corporate social responsibility, sustainability, ecosystem services, cost-benefit analysis, environmental economics.

JEL codes: A22, M14, Q51, Q57.

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In April 2015, The Dow Chemical Company ("Dow") announced a suite of 2025 Sustainability Goals that the company is implementing over the next ten years (Dow, 2015). Like many companies, Dow's 2025 Sustainability Goals include goals aimed at reducing its footprint through, for example, emissions reductions and freshwater intake reductions.

In addition to its footprint goals, Dow, in its 2025 Sustainability Goals, committed to generating $1 billion in business value through projects that are good for Dow's business and better for nature. To achieve this goal, Dow is developing a business decision process incorporating the consideration of the value of nature into all of its business decisions. The company has coined this goal the "Valuing Nature Goal," or simply the "Nature Goal."

At the same time, Dow, like all private companies, strives to increase total shareholder value. Project managers within the company are looking for ways to successfully advocate for the full business value of Nature Goal projects. They would like the business value to capture both the financial value of the project and the project's nature value in a way that is in line with shareholder needs and goals.

Corporate Sustainability Goals

The concept of sustainability has come under increasing focus during the last two decades. A Web of Science search reveals roughly one thousand published articles containing the term "sustainability" in 2000. That same search shows nearly 15,000 articles in 2016 (Web of Science, 2018). Similarly, the private sector's focus on sustainability has increased dramatically over the last decade. In 2011, slightly less than 20% of S&P 500 companies reported on sustainability; by 2016 the share had increased to 82% (Governance & Accountability Institute, 2017). Globally, three-quarter of companies, or nearly 3,600 companies, in the N100 – a KPMG sample of 4,900 companies that represent the top 100 companies, by revenue, in 49 different countries – reported issuing corporate responsibility reports in 2017 (Blasco and King, 2017).

Companies' sustainability goals have become more ambitious and more rigorous as they have developed over the years. For example, as of March 2018, nearly 370 companies had pledged to set emissions reductions targets that align with the most current climate science (Science Based Targets, 2018). Dow's Valuing Nature Goal aims to incorporate ecosystem service thinking into all of Dow's business decision-making processes. The aim of this goal, as Dow states on its website is:

> *At Dow, we're committed to making business decisions in a way that appreciates and incorporates the value of nature's services…If companies understand and value the benefits nature provides to their bottom line, they will be more likely to plan, manage and invest in these resources in smarter, more productive and mutually beneficial ways. (Dow, 2018)*

Natural Capital and Ecosystem Services

The U.S. Department of Commerce defines "natural capital" as the "earth's stock of natural assets" including human societies, animals, plants, and all nonliving environments (U.S. Department of Commerce, 2018). This stock of natural assets is a key component of the world's ecosystems, which the Millennium Ecosystem Assessment (MEA) defines as "a dynamic complex of plant, animal, and microorganism communities and the nonliving environment interacting as a functional unit" (MEA, 2005a, p. v).

Humans and businesses are an integral part of all ecosystems. The benefits that humans and businesses obtain from ecosystems are generally referred to as "ecosystem services." Any change in natural capital impacts an ecosystem's functioning and the provision of its ecosystem services. Ecologists and conservation scientists categorize ecosystem services into one of four groupings: (i) provisioning services; (ii) regulating services; (iii) cultural services; and (iv) supporting services. Table 1 provides a full description and example of each of these four ecosystem service groupings.

The Millennium Ecosystem Assessment, a groundbreaking report commissioned by then Secretary-General of the UN Kofi Annan, measured the impacts of human society on the environment. The assessment showed that 15 of the 24 ecosystem services assessed were currently being degraded or used unsustainably (Millennium Ecosystem Assessment, 2005a). Dow hypothesizes that by incorporating the ecosystem service impacts of a project into the decision-making process, the company would move toward decisions that are both better for business and better for nature. The challenge lies in developing a systematic way to account for the value of ecosystem services in a decision-making process.

Midland Brownfield Restoration Opportunities

In 2015, Dow was developing plans for the closure of an ash pond site in Midland, Michigan under the oversight of the Michigan Department of Environmental Quality. The ash pond site was initially constructed as a cooling pond in the 1940s to serve a coal-fired power plant. The ash pond site served as a cooling pond for nearly forty years until the coal-fired power plant was closed in the 1980s. The ash pond site covered 23 acres of land and was adjacent to both Dow's Michigan Operations plant and the Tittabawassee River, a roughly 70-mile river that runs through downtown Midland.

Traditionally, a site like the ash pond site would be remediated through capping – which involves leaving the ash in place and covering it with natural and synthetic materials – along with long-term treatment and/or monitoring of the groundwater.

At the same time, the City of Midland was looking to restore a 14.5-acre brownfield in what was an abandoned concrete facility, referred to as the 4-D property, that sat adjacent to the ash pond site. In its master plan, the City of Midland has prioritized beautification along the Tittabawassee River.[1]

Project managers at Dow were hoping to identify alternative restoration plans for the ash pond site that would enhance the level of ecosystem services provided by the restored site and better align it with the company's Valuing Nature Goal. However, Dow had already obtained cost estimates for the traditional cap and were preparing for implementation. So the project managers needed to find a way to advocate for additional costs to achieve the benefits of an alternative restoration plan that accounted for the value of ecosystem services in a way that would be convincing to Dow's stakeholders.

[1] https://www.ourmidland.com/news/article/Mayor-council-praise-plans-for-Poseyville-10932844.php

Alternative Ecological Restoration Plans

The first step was for Dow and external engineers to develop an alternative ecological restoration plan. The final alternative ecological restoration plan developed involved excavating all 90,000 cubic yards of ash from the site and restoring the landscape to native forest, prairie and wetland. In planning for the ecological restoration, Dow identified an opportunity for the City of Midland to implement a similar ecological restoration on its 14.5-acre brownfield with connecting trails and overlooks between the two sites. Together, these two restoration projects would improve nearly one-mile of riverfront in Downtown Midland and connect an expansive network of parks, open spaces, and trails in the city.

Figure 1 shows the three final restoration designs developed by the project team.[2] Figure 1(a) on the left depicts the restored site following the traditional restoration, where the site is capped and then covered in grass. Figures 1(b) and 1(c) depict the restored site following an ecological restoration on just the Dow site and both Dow and the City's site, respectively. The ecological restoration involves excavating and disposing of the ash and concrete, backfilling with clean soil to create various site features such as upland areas and wetland features, and planting the areas with native plants. Upon completion of the ecological restoration, the Dow site is expected to have more than 60 species of native plants, including trees, shrubs, and grasses.

[2] The complete project team included Dow employees, environmental engineers from AECOM, scientists from The Nature Conservancy, and collaborators from EcoMetrix Solutions Group.

Assessing Ecosystem Service Impacts

Project managers at Dow also needed a systematic way of comparing and assessing the ecological restoration design options in relation to a traditional capping remedy. Previously, Dow, The Nature Conservancy, and EcoMetrix Solutions Group had joined forces to create a specialized modeling tool, called the Ecosystem Services Identification & Inventory Tool, or "ESII Tool." The ESII Tool works as a free iPad application for data collection supported by a Web-based interface for ecosystem service modeling. It is designed to quickly and effectively generate information on the environmental impact of proposed changes to natural areas (Guertin et. Al, 2018). Dow decided that the ESII Tool was the appropriate tool to use to understand the ecosystem service tradeoffs between the restoration designs.

The ESII Tool output focuses on measuring ecosystem service performance for eight specific ecosystem services. Table 2 lists the eight ecosystem service groupings that are captured within the ESII Tool as well as the actual components measured within the tool. The ESII Tool provides two sets of metrics that allow for direct comparison of the traditional and ecological restoration alternatives.

First, for each of the 13 ecosystem services shown in column (B) of table 2, the ESII Tool calculates a percent performance metric. The percent performance metric rates how well the landscape cover of the restoration alternatives performs for a specific ecosystem service relative to the highest possible performance of that ecosystem service across all landscapes. These percent performance metrics are advantageous because they all allow for the direct comparison of the sites performance across two different restoration designs and across landscapes.

Second, for ten of the ecosystem services shown in column (B) of table 2, the ESII Tool calculates performance metrics for specified engineering unit outputs. These measured unit outputs are shown in column (C) of table 2 and measure the absolute performance of the restoration alternative.

Dow measured both the percent performance and unit output differences between the restoration alternatives. Dow began by looking at the percent performance metrics generated from each of the three restoration alternatives. These ESII Tool outputs are shown in figure 2. From figure 2, Dow identified five ecosystem services with the largest difference in percent performance between the traditional restoration alternative and ecological restoration alternative. The measured unit output for these five ecosystem services are shown in table 3.

Assessing Financial Costs

To properly advocate for the ecological restoration design, project managers at Dow needed to present a financial breakdown of the alternative restoration designs. Table 4 breaks out the costs separately for the Dow site and the Midland site for both the traditional restoration alternative and the ecological restoration alternative. The financial cost breakdown reveals that the ecological restoration design can have higher upfront costs, such as costs for planting, but that the long-term annual maintenance costs related to the ecological restoration alternative are always lower than that of the traditional restoration alternative. Project managers opted to consider the restoration alternative costs over the estimated life of the projects, assumed to be 30 years.

In assessing the financial costs of the restoration plans, both Dow and the City of Midland must consider how to appropriately discount these costs over the 30-year life of the projects. The discounting of future costs and benefits is necessary to make sure that these costs and benefits are expressed in terms of their value today. There are two types of discount rates: a private discount rate and a social discount rate. A private discount rate is the discount rate of a specific company or individual. A social discount rate, on the other hand, is the discount rate of society-as-a-whole. The U.S. Government's Office of Management and Budget (OMB) has guidelines on how to approximate both of these discount rates (OMB, 2003).

Assessing Co-Benefits

In addition to the financial project costs, Dow and Midland City officials want to understand how the ecosystem service impacts translate into a set of relevant co-benefits. Co-benefits gained popularity after being used to refer to the non-climate benefits of climate mitigation policies by the Intergovernmental Panel on Climate Change in a 2001 report (IPCC, 2001, p. 51). Although still frequently used in the context of climate mitigation strategies, today, co-benefits can refer to any number of benefits that are not the primary aim of a policy or decision.

The MEA listed out eight potential services that business and industries may receive from ecosystems, or that may be affected by the health of ecosystems (MEA, 2005b): (i) license to operate; (ii) corporate image; (iii) reputation & brand risk; (iv) cost of capital & perceived investor risk; (v) access to raw materials; (vi) operational impacts and efficiencies; (vii) new business opportunities; and (viii) innovative technologies for new opportunities. Some of these services directly feed into Dow's financial reporting through, for example, operation and maintenance costs (e.g., operational impacts and efficiencies, revenue generation (e.g., new business opportunities), or through a company's borrowing costs (e.g., cost of capital & perceived investor risk). Some of the other services will likely have a more indirect impact on Dow's long-term financial services (e.g., license to operate and corporate image) which makes them harder to quantify in financial terms.

Midland City officials also want to understand their potential co-benefits from the restoration scenarios. Unlike Dow, the stakeholders for the City of Midland are the residents of Midland. The MEA also provides a framework for considering how ecosystem services affect human well-being, such as through health services – via food quality, water quality and air quality – or through recreational and cultural services – via trails, fishing opportunities, or aesthetics. The City of Midland knows that restoring brownfields in an ecologically conscious way has the potential to provide significant benefits to Midland residents living around the site. For example, a recent study found that property values increased, on average, by five percent to 11.5 percent following a brownfield cleanup (Haninger, Ma and Timmins, 2017). Other studies have considered the benefits of outdoor spaces for fishing, boating or hiking, to name a few (Rosenberger, 2016).

Conclusion: Evaluating the Alternative Restoration Plans

Both Dow and the City of Midland need to present evidence to their respective stakeholders on which restoration plan to adopt. Dow's presentation of its preferred restoration plan needs to include evidence on why the preferred restoration plan provides more shareholder value than the other alternatives, including the preferred restoration plan's value generated from its provisioning of ecosystem services. Dow project managers are aiming to develop a data-based argument as to how projects can offer shareholder value while also addressing the company's commitment to nature in its Valuing Nature Goal. The City of Midland needs to convince its citizens that its preferred restoration plan will be a cost-effective use of taxpayer money that provides benefits to the citizens. The two organizations are looking to include arguments based on both direct project costs and the co-benefits of the projects related to its provision of ecosystem services.

Discussion Questions

1. What are the appropriate discount rates that Dow and the City of Midland should use to estimate the net present value of the possible restoration plans?
2. What is the net present value of the possible restoration plans? How does the choice of a discount rate affect the net present value?
3. For which restoration plan should Dow project managers advocate? Why? How does the preferred restoration plan support Dow's Valuing Nature Goal? How does the preferred restoration plan enhance Dow's stock value?
4. For which restoration plan should the City of Midland advocate? Why? How does the preferred restoration plan support the City's goals?
5. What co-benefits should Dow project managers be considering when assessing the possible restoration plans? How might they include these co-benefits in their review of the plans? Does the inclusion of the co-benefits affect Dow's choice of which restoration plan to implement?

6. What co-benefits should the City of Midland be considering when assessing the possible restoration plans? How might they include these co-benefits in their review of the plans? Does the inclusion of the co-benefits affect the City of Midland's choice of which restoration plan to implement?
7. How does Dow's choice of a restoration plan affect the City of Midland? How does the City of Midland's choice of a restoration plan affect Dow?

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Table 1. Ecosystem Service Groupings

	Ecosystem Services	Description	Example Service
	(A)	(B)	(C)
(1)	Provisioning Services	Goods or products obtained from ecosystems	Freshwater
(2)	Regulating Services	An ecosystem's control of natural processes	Wetland purification of water
(3)	Cultural Services	Nonmaterial benefits obtained from ecosystems	Recreation
(4)	Supporting Services	Natural processes that maintain other ecosystem services	Water cycling

Source: (Hanson et al., 2012).

(a) Traditonal Restoration, All Sites

(b) Ecological Restoration, Dow Site, and Traditional Restoration , City Site

(c) Ecological Restoration, All Sites

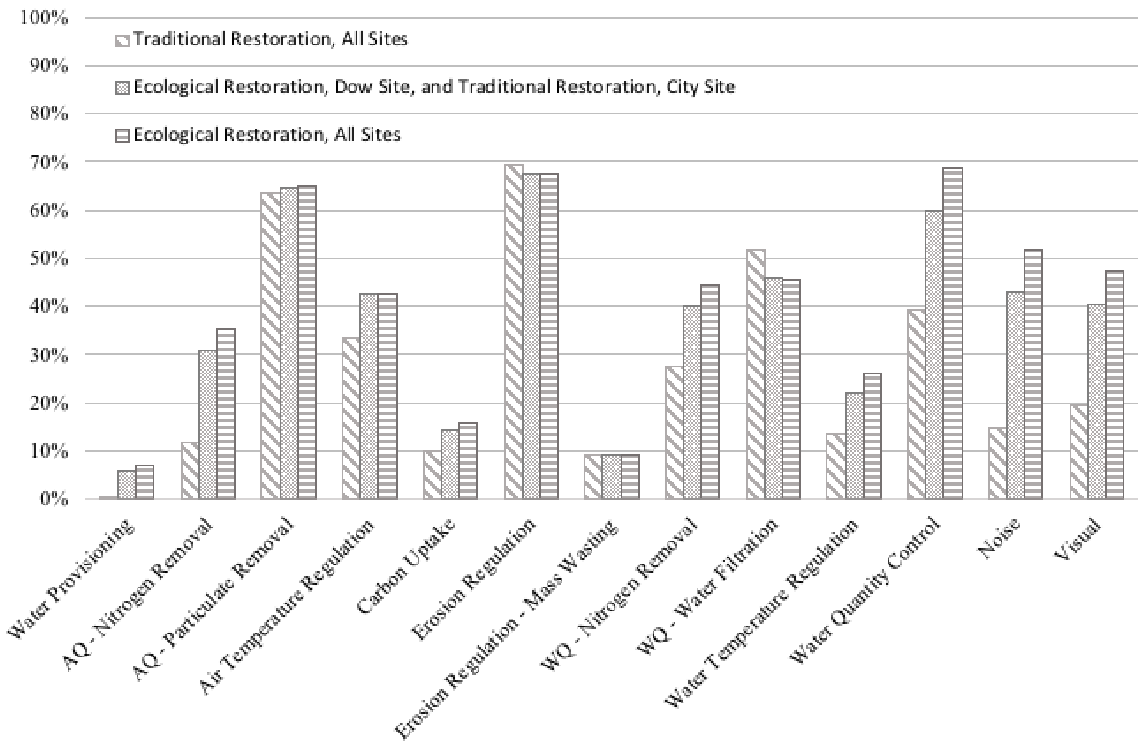
Source: (Guertin et al., 2018).

Figure 1. Alternative restoration designs

Table 2. The ESII Tool's Ecosystem Service Measurements

Ecosystem Services Grouping (A)	Ecosytem Services (B)	Measured Unit Outputs (C)
(1) Water Provisioning	Water Provisioning	Gallons/Foot^2; Gallons/Map Unit
(2) Air Quality Control (AQ)	Nitrogen Removal	Pounds/Acre/Year; Pounds/Map Unit/Year
	Particulate Removal	Pounds/Acre/Year; Pounds/Map Unit/Year
(3) Climate Regulation	Air Temperature Regulation	BTU Reduction Shade (BTU/Foot^2/Hour); BTU Reduction Shade (BTU/Map Unit/Hour); BTU Reduction Shade (BTU/Foot^2/Day); BTU Reduction Shade (BTU/Map Unit/Day)
	Carbon Uptake	No Unit of Measure
(4) Erosion Regulation	Erosion Regulation	Acres <35%
	Erosion Regulation - Mass Wasting	No Unit of Measure
(5) Water Quality Control (WQ)	Nitrogen Removal	Nitrogen Removal - Milligrams/Liter; Max Nitrogen Removal - Milligrams/Liter
	Water Filtration	TSS Removal - Milligrams/Liter; Max TSS Removal - Milligrams/Liter
(6) Water Temperature Regulation	Water Temperature Regulation	No Units of Measure
(7) Water Quantity Control	Water Quantity Control	Water Quantity Runoff - Inches Across Site; Water Quantity Runoff - Gallons/Acre; Water Quantity Runoff - Gallons/Map Unit
(8) Aesthetics	Noise	Noise Attenuation - Decibals
	Visual	Visual Screening - Acres

Source: (Guertin et al., 2018) and "The ESII Tool," available at http://www.esiitool.com/.



Source: (Guertin et al., 2018).

Figure 2. ESII Tool output: percent performance for alternative restoration designs

Table 3. ESII Tool Output: Measured Unit Outputs for Ecosystem Services with Largest Percent Performance Difference

	Ecosystem Services	Measured Unit Outputs	Traditional Restoration, All Sites	Ecological Restoration, Dow Site, and Traditional Restoration, City Site	Ecological Restoration, All Sites
	(A)	(B)	(C)	(D)	(E)
(1)	AQ - Nitrogen Removal	Pounds/Year (Total)	54.83	144.35	160.00
(2)	Air Temperature Regulatic	BTU Reduction Shade (BTU/Hour, Site Total)	23,000,000	56,000,000	67,000,000
(3)	WQ - Nitrogen Removal	Milligrams/Liter (Area Weighted Average)	0.13	0.15	0.15
(4)	WQ - Water Filtration	TSS Removal (Milligrams/Liter, Area Weighted Average)	13.49	11.23	11.16
(5)	Water Quantity Control	Water Quantity Runoff (Gallons)	2,419,060	1,240,826	1,043,422

Source: (Guertin et al., 2018).

Table 4. Estimated Financial Costs of Alternative Restoration Designs

	Dow Site		Midland Site	
	Traditional Restoration	Ecological Restoration	Traditional Restoration	Ecological Restoration
Plantings	$ 619,223	$ 1,051,024	$ 164,223	$ 212,128
Other	$ 4,792,849	$ 2,775,684	$ 449,742	$ 1,589,082
Installation Costs	**$ 5,412,072**	**$ 3,826,708**	**$ 613,965**	**$ 1,801,210**
Mowing & Grounds Maintenance	$ 13,800	$ 1,685	$ 7,200	$ 591
Other	$ 43,730	$ 11,794	$ -	$ 4,139
Annual Operations & Maintenance Costs	**$ 57,530**	**$ 13,478**	**$ 7,200**	**$ 4,730**

Notes: Plantings includes planting and invasive species removal. Other installation costs include site features (such as fencing), construction oversight costs, and excavation and capping. Other annual operations & maintenance costs include invasive management, environmental monitoring, and regulatory reporting.