FE310

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Full Cost Accounting in Environmental Decision-Making[1]

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Introduction

The term “full cost accounting” (FCA) is used in a variety of settings. The State of Florida (Florida Statute 403.7049) requires local governments to employ FCA in solid waste operations, and the Governor's Commission for a Sustainable South Florida recommends the use of FCA in plans to restore the Everglades.[3] There are several questions that need to be addressed:

- What is FCA?
- What are its economic foundations?
- How is FCA applied?
- What tools are available for its implementation?

This document presents introductory answers to these questions and highlights some general references on FCA and applications in Florida.

Individuals, corporations, and governments make important decisions every day. To make the best decisions, they need to accurately weigh the relative benefits and costs of various alternatives. For example, the decision to purchase a home involves a comparison of the positive and negative aspects of each potential site in order to choose the one that meets a household's needs at an affordable price.

Businesses go through a similar process when they decide on new production processes or a location for a factory. Sometimes, though, choices affect others in ways that create conflict. The smokestack emissions from a new factory, for instance, might soil laundry drying on the clotheslines of neighboring households. If the factory is required to replace the soiled clothes or purchase dryers for the affected households, then the business might choose to relocate elsewhere. Alternatively, if the households know that there will be a factory nearby with damaging emissions, they might pick a different place to live. The identification of the responsible party in such cases is typically considered a legal question, but the example shows how difficult it can be to make satisfying decisions in the absence of information on the *full* range of costs and benefits of the relevant choices.

In general, the term “full cost accounting” refers to the process of collecting and presenting information to decisionmakers on the trade-offs

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inherent in each proposed alternative. The process can be especially important for government agencies that represent a variety of interests when deciding how to allocate public funds and/or natural resources.

The example that we use in this document supposes that a government land use agency is deciding what to do with a large coastal wetland near a rapidly growing metropolitan area. The agency recognizes that the wetland can be filled to create space for further urban development or preserved as part of a larger recreational reserve for the local community. It also recognizes that a compromise alternative is possible, whereby some portions of the wetland are preserved and other portions are filled and developed. However, the agency is uncertain which approach to take, so they decide to use a FCA approach to learn more about the costs and benefits of each alternative.

Economics of Full Cost Accounting

The fundamental economic concept in FCA is ***opportunity cost***. This definition of cost refers to the value of opportunities that are given up when a choice is made to use a *limited* resource for a specific purpose. For example, the materials and equipment (e.g., soil and tractors) used to fill our example wetland cannot be used elsewhere. The opportunity cost of using these materials and equipment is their value in other uses, which, if markets are working properly, is simply their current market price. Now consider that the wetland, once filled, cannot be used to support local wetland species and other valuable activities. In this case, the opportunity cost of filling the wetland is the forgone value of the wetland as an animal habitat, a natural filtration system, etc. However, since there is no market for wetlands (in most places), there is no market price available to indicate the *full* opportunity cost of filling and using the wetland. Economists have developed techniques to estimate opportunity costs when decisions involve values such as those for wetlands that are not directly priced in the marketplace (Table 1). These techniques are introduced in the next section.

Opportunity costs are typically measured in terms of ***direct*** or ***indirect*** changes in ***market values***, but can also be measured as changes in ***non-market values*** (i.e., not reflected in market transactions). In the wetland example, the cost of the fill materials and equipment is part of the market cost, whereas the value of the wetland unavailable for animal habitat is a non-market cost of the project. The price of the fill materials is a direct measure of resource value from the marketplace, but there may be other values (e.g., wetland-related waterfowl hunting) that can be indirectly tied to market activities (e.g., purchases of hunting equipment or the cost of travel to specific hunting spots).

Opportunity costs can also be described according to legal responsibilities assigned for paying the costs. Costs for which each resource user is legally responsible for paying are ***private costs***. The material used in filling the wetland is a private cost because payment of a fair market price is required to use the material. Opportunity costs that are not the private responsibility of the resource user are deemed ***external costs*** or (negative) ***externalities***. Both private and external costs are somewhat tricky to assess. For example, external costs occur when there are no laws stating that the person who fills the wetland must compensate for lost wetland-related activities, and private costs occur when there are laws or regulations governing the use of a resource because business operators recognize them as another cost of running their operation. In fact, most of the environmental regulations in the United States were created to “internalize” a larger range of opportunity costs in the decision-making processes of individuals and businesses. Laws governing emissions from factory smokestacks, for instance, were developed to deal with external costs like the soiled laundry mentioned in the Introduction. Similar laws and regulations exist to govern the use of wetland property to prevent damage to natural systems. Note that an action can also generate positive externalities or external benefits that are paid for by one group but enjoyed by others. For example, an investment in new landscaping not only improves the value of a home, it may also provide benefits to neighbors or passers-by who enjoy the view.

From the broad perspective of a government agency, there may be no distinction between private and external costs. All decreases in value related to a decision to use a limited resource are ***social***

opportunity costs, while all increases in value are termed ***social benefits***. FCA is meant to capture as much information as feasible about these social benefits and opportunity costs. However, there is a limit to the amount of FCA information that can be feasibly collected for a given project because this information is costly to obtain. The costs of conducting a FCA analysis and any other costs that are incurred during the decisionmaking process are called ***transaction costs***. It would obviously be unwise to pursue a FCA study to the point where the transaction costs of the analysis are greater than the social benefits generated by the project under review. In fact, economic efficiency dictates that FCA information should be collected to the point where the cost of an additional amount of information just equals the additional benefit that information will generate.

Procedure and Tools of Full Cost Accounting

There are four general steps of a complete FCA analysis:

1. Identification of stakeholders and relevant values.
2. Generation of project alternatives.
3. Evaluation of the effects of each alternative on stakeholders.
4. Tabulation, adjustment, and reporting of results.

Identification of Stakeholders and Relevant Values

The first step is to identify all ***stakeholder*** groups that have an interest in the policy or plan being considered. A thorough inventory of stakeholders includes those with direct and indirect market interests, as well as those who have a stake in the non-market aspects of the project. The indirect stakeholders are the groups in the regional economy that are affected by changes in the activities of the direct stakeholders after a project is implemented. A special effort should be made to identify the stakeholders whose interest in the project cannot be expressed as changes in market values. Such interests could relate to non-market environmental or cultural characteristics that may be affected by the project alternatives under consideration.

The two main stakeholder groups in the wetland example are those interested in using the filled land for residential or commercial developments and those who prefer that the area remain in a natural state. Each of these groups represents a variety of entities, and it is possible for the same entity to have a stake in both groups. For instance, a household interested in the potential home sites of a filled wetland may also enjoy hunting the waterfowl supported by the wetland in its natural state. A careful assessment of the stakeholders in the early stages of a FCA helps to clarify conflicting interests and reveal potential areas for compromise as the analysis progresses.

Generation of Project Alternatives

The next step is to create a list of feasible project alternatives based on recommendations by scientists and the stakeholders who are closely involved with the project subject matter. This list includes options that are feasible given the characteristics of the study area and the goals of the project. A complete list of alternatives also includes the "no project" choice. In our wetland example, the three general alternatives are development (fill and develop the area to support urban growth), preservation (set aside the area as a part of a recreational reserve), and a combination of development and preservation. The total preservation alternative represents the “no project” alternative in this case. Many decisions are more complicated than the wetland example and will have more alternatives to consider. Regardless of the nature of the decision, however, it is important to involve the community in the early phase of planning to generate alternatives that represent the full range of interests. The expert opinions of scientists are also crucial at this point, given the characteristics of the natural environment.

Evaluation of the Effects of Each Alternative on Stakeholders

The third step of a FCA analysis examines the potential direction and magnitude of each alternative's effect on the recognized stakeholder groups. In general, increases in stakeholder values are

counted as social benefits of a project alternative, whereas decreases in value are counted as social opportunity costs. There are two underlying procedures in this step. First, the potential physical and environmental effects of each project alternative must be identified. Second, to the extent possible, these physical and environmental effects are translated into changes in stakeholder values and compared across alternatives. The first procedure is the purview of the engineers and physical scientists (geologists, biologists, etc.), whereas the second procedure is largely left up to the social scientists (i.e., economists and sociologists).

In the wetland case, hydrologists determine how filling the wetland affects the flow and quality of water in the area, and biologists estimate how the local flora and fauna, including waterfowl, are affected. An economist then uses the information on the expected waterfowl population without the wetland to estimate the potential opportunity costs of forgone waterfowl-related recreation (hunting, bird watching, etc.) if the wetland is filled. There are, of course, other stakeholder values affected by the changes in the hydrologic and biologic regimes. Some people may simply prefer to preserve the wetland for the *option* to use them later or for future generations to enjoy as a *bequest*. A complete FCA analysis of the wetland decision presents as much information as feasible on the expected changes in value for the various alternatives. Economists have specialized tools to measure the change in market and non-market values related to current conditions and various project alternatives.

Predicting Market Value Changes

An ***economic impact analysis*** predicts the direction and magnitude of changes in key economic indicators such as employment and income, while ***fiscal impact analysis*** measures the related changes in tax revenues and disbursements. Both types of analysis help people to understand how a project such as our example of a new residential development on a filled wetland affects the local and regional economy. A new residential development brings new households and the accompanying income and labor supply to a community. Such a development also requires infrastructure (roads, schools, etc.) and provides a source of tax revenues for local governments. Ultimately, most policy choices such as the decision to fill and develop a wetland act as an "injection" that ripples through the economic system. Economic and fiscal impact analyses are designed to account for the market-based changes (opportunity costs and benefits) in stakeholder values that are expected to occur with such an injection.

Predicting Non-Market Value Changes

Changes in non-market values associated with an alternative are measured using information that stakeholders provide about their preferences or are derived implicitly from market data. The ***contingent valuation (CV)*** method questions people about their willingness to pay for hypothetical (or actual) policies that affect the allocation of resources. This approach is commonly used to estimate the value of changes in the condition of the natural environment where willingness-to-pay is used to gauge the potential economic benefits or opportunity costs (i.e., changes in stakeholder values) related to resource management decisions. For example, the CV approach is used to determine how much residents would be willing to pay for the recreational opportunities supplied by a healthy wetland system. This survey information is then used to estimate the potential recreational opportunity cost of filling the wetland or, conversely, the benefit of preserving the wetland.

Another survey technique called ***conjoint analysis*** is used to determine the *relative* value that people place on the attributes of a product or experience. This information is used to estimate the value of policies that change the distribution and/or availability of attributes. In the wetlands case, a conjoint analysis is conducted to learn the relative value that people place on various attributes of a wetland such as the ability to filter water and/or support wildlife. The change in value (opportunity cost) from filling a portion of the wetlands is measured by the value of the lost wetland attributes.

The value of a resource is also inferred from actual expenditures on related activities. Thus, the value of a wetland area is derived from expenditures on wetland-related activities such as waterfowl hunting or wildlife observation. This type of resource

valuation is referred to as ***hedonic pricing***. The so-called ***travel cost*** approach is a popular hedonic method that estimates the value or price of environmental amenities based on the cost of traveling to recreational areas. This approach is useful because travel expenditures give an idea of the minimum cost that people are willing to pay for access to environmental amenities. Hedonic pricing is also used to determine the portion of property value that is attributed to its proximity to natural amenities.

In summary, the common goal of the economic tools introduced here is to express the value of changes in stakeholder well-being in monetary terms, so the differences may be directly compared. It is important, however, that information on all potential changes in stakeholder value is carried to the final step of the FCA process, even if some of the changes in value cannot be quantified.

Summarizing and Comparing Alternatives

The last step is to summarize and compare results from the FCA analysis that reflect the changes in stakeholder values expected with each proposed project alternative. These summary results are intended to help highlight the trade-offs inherent in the resource management decision. The two general approaches that are used to organize, evaluate, and summarize and compare the information on the changes in stakeholder values are benefit-cost analysis and cost-effectiveness analysis. The actual approach used for a given FCA analysis depends on the funds available for the analysis and the target audience. Also, a summary account for FCA is not complete until risk and discounting adjustments are considered.

Benefit-Cost Analysis

A traditional ***benefit-cost analysis*** summarizes the changes in stakeholder value as a social net economic value for each alternative. The ***net economic value*** of an alternative is simply the total increase in stakeholder value (benefits) that the alternative is expected to yield minus the total expected decrease in stakeholder value (opportunity costs). This measure is frequently expressed as a ratio so that, assuming all changes in stakeholder values have been effectively quantified, the most efficient alternative is the one with the largest benefits relative to opportunity costs. Note that benefit-cost analysis requires information on both the positive and negative changes in stakeholder value. To illustrate, suppose that the policy of filling and developing the wetland increases some stakeholder values by $10 million (benefit) and decreases other stakeholder values by $8 million (opportunity cost). The net economic value of this project is $2 million with a benefit-cost ratio of 1.25 (benefits/costs = 10/8 = 1.25). However, we must also subtract the transaction cost of conducting the FCA analysis, say $1 million, from this figure to get a final net economic value of $1 million and a ratio of 1.1 (benefits/total costs = 10/(8+1) = 1.11). Any alternative (e.g., preservation or a compromise option) with a net economic value greater than $1 million is considered more favorable from the standpoint of economic efficiency.

Cost-Effectiveness Analysis

Sometimes decision makers are only concerned with the negative changes in stakeholder value or the opportunity costs of each project or policy alternative. This often occurs when each alternative has the same expected benefits, or it is not possible to obtain meaningful estimates of positive changes in stakeholder value. In this case, ***cost-effectiveness analysis*** is used to compare the opportunity costs of each alternative. Essentially, the cost-effectiveness approach looks for the alternative that represents the cheapest (i.e., least expensive opportunity cost) way to achieve the project or policy objectives. If the community in our wetland example decides on a compromise solution, then cost-effectiveness analysis is used to explore the opportunity cost of various development/preservation configurations. In this case, the information from the FCA process allows people to compare the opportunity costs of filling different percentages and locations of the total wetland for development.

Risk and Discounting

Before the final results of a FCA analysis are presented, it may be necessary to adjust the summary information for ***risk*** and ***time preferences***. The analyses in the FCA process use information about future events to predict anticipated changes in stakeholder value via different project alternatives.

The information about future events is usually based on the best available knowledge, but it is not 100 percent certain that events will occur as predicted. Furthermore, people are typically less sure about information based on events in the distant future. The FCA results must be adjusted to reflect this inherent uncertainty and the risk that predictions are not completely accurate.

For example, if it is understood that the $10 million in project benefits are only 50 percent likely to occur, then the ***expected value*** of the these benefits is only $5 million ($10 x 50%). If the project opportunity costs are calculated in a similar manner and subtracted from the expected value of the benefits, then the result is the ***expected net economic value*** of the project. Note that the expected net economic value can be different from the net economic value of the project if the benefits and opportunity costs have different levels of associated risk. Information on the risk and the expected value of alternatives should always be included in FCA if it is available. Similar procedures are used to adjust for risk for each alternative when using Benefit-Cost or Cost-Effectiveness approaches.

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Additional Notes:

3. The definition of FCA as outlined in this document is meant to represent the complete range of costs corresponding wih economic principles. In some applications, practical employment of FCA entails a subset of all economic costs. For example, in solid waste operations, Florida's definition of FCA excludes external costs.

Table 1. Full Cost Accounting in Action: Wetlands Permitting in Florida

In July 2000, the U.S. Army Corps of Engineers (Corps) issued a formal evaluation* of the national dredge-and-fill wetland-permitting program. The evaluation was a response to concerns about rapid development in critical areas of the western Everglades. However, the scope of the evaluation was broad and contained recommendations that would affect the way wetlands are treated throughout the state of Florida. The Corps followed the first few steps of FCA analysis by defining alternative actions and identifying stakeholder groups. Unfortunately, though, at least two stakeholder groups have expressed concern over the Corps' interpretation of changes in values predicted in the third FCA step.

A development interest group retained a private consultant to critique the Corps' preliminary plans for wetland protection issued in an early draft of the evaluation. The study conducted for the development group used *impact analysis* techniques to predict the expected changes in stakeholder value associated with the Corps' recommended wetland/development allocations. The study suggested that the Corps' wetland permitting plans would limit development in Lee and Collier Counties and decrease stakeholder values in Southwest Florida. This speculated decrease in stakeholder values would be an *opportunity cost* of the new wetland permitting policies. In light of the development group report, the Corps significantly modified their plans to allow a greater degree of development at the expense of wetland protection.

An environmental group hired a university economist to review the Corps' evaluation and the development group report.** The professor drew heavily on FCA principles in his critique. He found that both analyses focused exclusively on market opportunity costs of preservation and ignored non-market opportunity costs associated with filling wetlands. Similarly, neither analysis considered the potential non-market benefits available from wetland preservation. Taken together, these oversights generally tend to bias permitting decisions towards development and away from protection.

The Corps' final decision on the wetlands permitting process is still pending. Hopefully, the comments provided by the public, including the two critiques described above, will help the agency and the community to better understand the full costs (and benefits) of any given policy.

* The evaluation was contained in a report titled the “Environmental Impact Statement on Improving the Regulatory Process in Southwest Florida.” Information on this project is available at http://www.saj.usace.army.mil/permit/swfeis/contents.htm.

** See http://www.nwf.org/everglades/corpscritique.html for a summary.